Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **2006**	2. REPORT TYPE	3. DATES COVERED **00-00-2006 to 00-00-2006**

4. TITLE AND SUBTITLE **Medical Risk in the Future Force Unit of Employment. Results of the Army Medical Department Transformation Workshop V**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Rand Corporation,1776 Main Street,PO Box 2138,Santa Monica,CA,90407-2138**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**		**107**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

This product is part of the RAND Corporation technical report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

TECHNICAL
REPORT

Medical Risk in the Future Force Unit of Employment

Results of the Army Medical Department Transformation Workshop V

David E. Johnson, Gary Cecchine

Prepared for the United States Army

Approved for public release; distribution unlimited

RAND ARROYO CENTER and RAND HEALTH

The research described in this report was sponsored by the United States Army under Contract No. DASW01-01-C-0003.

Library of Congress Cataloging-in-Publication Data

Johnson, David E., 1950 Oct. 16-
Medical risk in the future force unit of employment : results of the Army Medical Department Transformation Workshop V / David E. Johnson, Gary Cecchine.
p. cm.
"TR-302."
"This report continues the task of documenting the Army Medical Department's (AMEDD) process of identifying and addressing medical issues related to the Army's transformation to the Future Force. It describes the AMEDD Transformation Workshop (ATW) V, conducted at the RAND Corporation Washington Office 25–28 May 2004, and includes an analysis and discussion of the workshop results."—Pref.
Includes bibliographical references.
ISBN 0-8330-3905-9 (pbk.)
1. United States. Army—Medical care. 2. United States. Army Medical Dept. 3. United States. Army—Reorganization. I. Cecchine, Gary. II. Rand Corporation. III. United States. Army Medical Dept. IV. Army Medical Department Transformation Workshop (5th : 2004 : Washington, D.C.) V. Title.
[DNLM: 1. United States. Army—Congresses. 2 United States. Army Medical Dept—Congresses. 3. Military Medicine—organization & administration—United States—Congresses. 4. Delivery of Health Care—organization & administration—United States—Congresses. WB 116 J66m 2006]

UH223.J665 2006
355.3'450973—dc22

2005036286

Published 2006 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
201 North Craig Street, Suite 202, Pittsburgh, PA 15213-1516
RAND URL: http://www.rand.org/
To order RAND documents or to obtain additional information, contact
Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

Preface

This report documents the Army Medical Department's (AMEDD's) continuing process of identifying medical issues in the Army's transformation to the Future Force. It contains an assessment of the AMEDD Transformation Workshop V, conducted at the RAND Corporation Washington Office, 25–28 May 2004. The report describes the organization of the workshop, objectives, the scenario used, and the analysis methodology employed. Finally, the report provides observations and conclusions. The methodology employed and the results should be of general interest for medical force planners, both within the Army and across the Department of Defense. Other related studies include the following:

David E. Johnson and Gary Cecchine, *Conserving the Future Force Fighting Strength: Findings from the Army Medical Department Transformation Workshops,* MG-103-A, 2004.

David E. Johnson and Gary Cecchine, *Medical Risk in the Future Force Unit of Action: Results of the Army Medical Department Transformation Workshop IV,* TR-253-A, 2005.

David E. Johnson, Gary Cecchine, and Jerry Sollinger, *Army Medical Department Transformation: Executive Summary of Five Workshops,* MG-416-A, 2006.

The Commanding General, U.S. Army Medical Department Center and School sponsored this work, which was conducted jointly by RAND Arroyo Center's Manpower and Training Program and RAND Health's Center for Military Health Policy Research. RAND Arroyo Center, part of the RAND Corporation, is a federally funded research and development center sponsored by the U.S. Army. Comments and inquiries should be addressed to the authors.

For more information on RAND Arroyo Center, contact the Director of Operations (telephone 310-393-0411, extension 6419; FAX 310-451-6952; email Marcy_Agmon@rand.org), or visit Arroyo's web site at http://www.rand.org/ard/.

Contents

Figures

Tables

Summary

This report documents the Army Medical Department's continuing process of identifying medical issues in the Army's transformation to the Future Force. It contains an assessment of the AMEDD Transformation Workshop (ATW) V; describes the workshop's organization, objectives, scenario, and analysis methodology; and provides observations and conclusions.

The purpose of this workshop was to continue the assessment, begun in ATWs I–IV, of the medical risks associated with emerging Army operational concepts and the capacity of the AMEDD to mitigate these risks. ATWs I–III focused on medical risk in a Unit of Action (UA) within a theater that had a defined echelons-above-UA Health Service Support (HSS) system (a 44-bed Combat Support Hospital [CSH]). Based in part on these initial workshops, the AMEDD determined that a 44-bed CSH would likely be insufficient, and it set out to determine what HSS system would be required at echelons above UA. ATW IV assessed the medical risk and demand on an echelons-above-UA HSS system that 76 casualties from a single UA would create during a simulated 12-hour battle. The principal focus of ATW V was to continue the process of establishing the casualty demand data that must be addressed by the echelons-above-UA HSS system. It involved four UAs (and supporting units of employment [UE]) with 429 casualties over a 100-hour simulated battle. Thus, the principal purpose of ATW V was to provide analytical support to the AMEDD to assist it in designing the HSS system above the UA level.

Background

The Army's transformation to the Future Force not only posits dramatically different equipment, it also envisions radically new ways of fighting. One aspect of future Army operations that is of particular importance is the employment of widely dispersed units moving rapidly across the battlefield. These operational concepts potentially pose significant challenges for the units that support the combat elements. In 1998, the AMEDD began an analytical effort to gain insight into the challenges for HSS posed by emerging Army transformation concepts. Over the next few years, AMEDD conducted two games and several workshops to provide further insight into how it could best support the Army as it transformed.

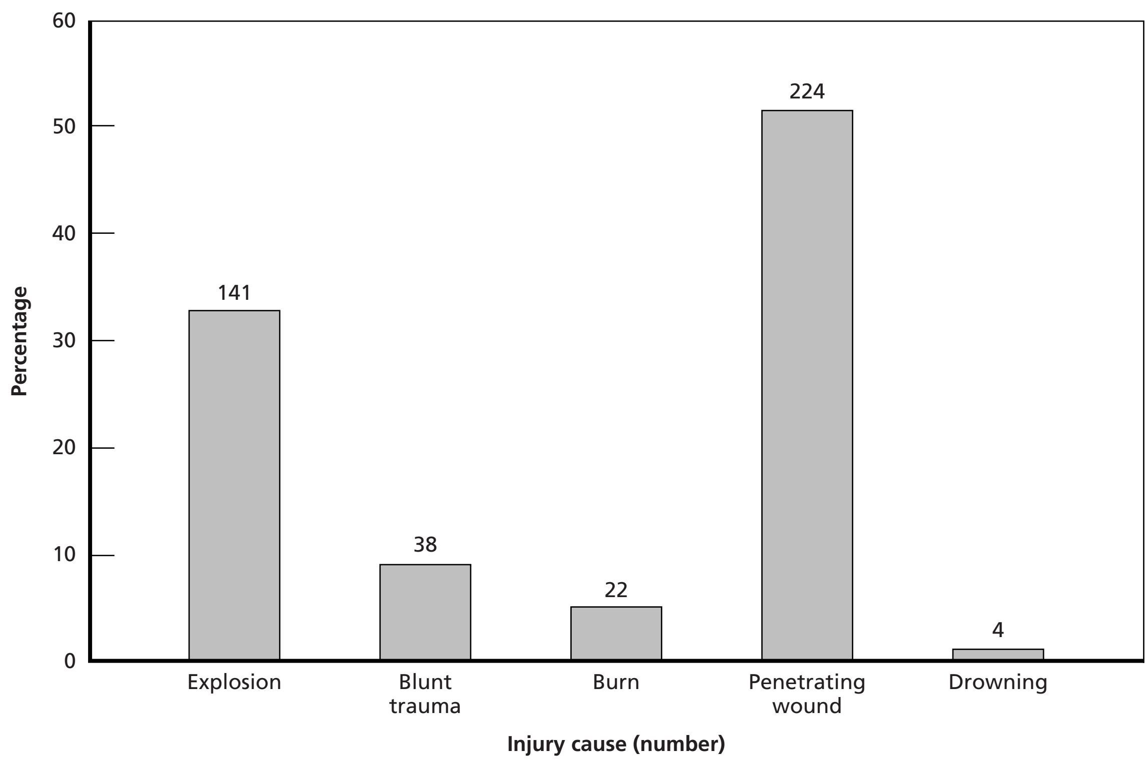
AMEDD Transformation Workshop V

In collaboration with the Center for AMEDD Strategic Studies, RAND designed, organized, facilitated, and provided analytic support to the fifth in a series of ATWs, conducted from 25–28 May 2004. The workshop was supported by subject matter experts (SMEs), who examined the ability of an envisioned UA HSS structure to support Future Force combat operations, as employed in a scenario provided by the U.S. Army Training and Doctrine Command (TRADOC).

Casualties Were Determined Based on an Army Scenario and Simulation Results

Casualty data for ATW V were provided by the AMEDD, which derived it from simulation casualty data, based on a Caspian 2.0 scenario, provided by the TRADOC Analysis Center (TRAC).[1] The approximately 100-hour battle resulted in 429 casualties among the four UAs and soldiers from the UE_x and UE_y in the UA's area of operations (AO).[2] Figures S.1 and S.2 show the distributions of the causes of the casualties and their wound types, respectively.

Figure S.1
Causes of Injuries of 429 Casualties

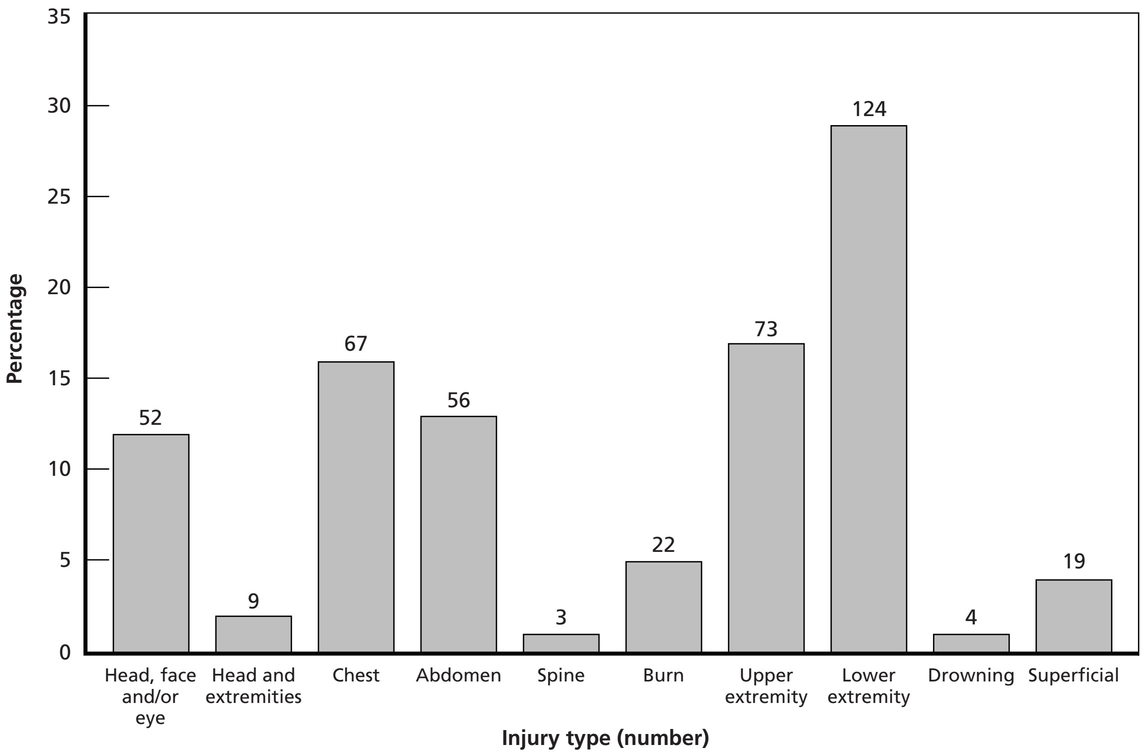


RAND *TR-302-S.1*

[1] Technically, soldiers wounded or killed are known as *casualties.* They are referred to as *patients* once they have entered the medical system above the level of first responder (e.g., combat medic) care. For simplicity, we use the term *casualty* throughout this report.

[2] UE_x and UE_y are the two command echelons above the UA.

Figure S.2
Types of Injuries of 429 Casualties



RAND *TR-302-S.2*

The simulation for ATW V depicted Future Combat System (FCS)-equipped maneuver UAs, operating as part of a UE_x and UE_y, conducting an attack to isolate the enemy's capital city and defeat enemy forces as part of the overall campaign objective of reinstating a legitimate government. The UE_y operated in a physical battlespace of over 500 kilometers by 225 kilometers.

The results of this UE-level simulation were the most current available for ATW V. How representative they are of what might occur in future operations is unknown, given the limited number of Army Future Force simulations conducted as of time of ATW V. More simulations are necessary to validate and expand the utility of these outcomes for Army force structuring and concept development efforts.

ATW V Questions and Answers

The workshop SMEs were asked to answer the following questions:

- What was the disposition of casualties (casualty outcomes) at the end of the scenario?
- What was the status of the HSS system at the end of the scenario?
- How many casualties required further evacuation and treatment at echelons above the UA?

What Was the Disposition of Casualties (Casualty Outcomes) at the End of the Scenario?

The Vector-in-Command (VIC) simulation generated 1,102 loss-producing events that resulted in 429 wounded-in-action (WIA) casualties during the approximately 100-hour battle. The percentages of casualties who died of wounds (DOW) and who died prior to reaching a medical treatment facility (killed in action [KIA]) in ATW V were similar to those in previous workshops, even though they were based on different scenarios (Johnson and Cecchine, 2004). This similarity is likely because of the robustness (or lack thereof) of the UA HSS system, the types of combat operations depicted in the scenarios, and similar (and plausible) estimations of casualty distributions based on the simulations.

A significant difference from past workshops was the higher rate of limb loss estimated in ATW V. While some of this difference may be attributed to better methods of estimation, because ATW V participants were directed to document likely amputations more clearly than in past workshops, it is nonetheless worth noting. Limb loss occurred in 58 casualties, representing 13.5 percent of all casualties. A portion of these limb losses were likely unpreventable, based on the description of their wounds. However, 22 casualties were described as having salvageable limb wounds but were amputated nonetheless, representing 38 percent of the total estimated limb loss events.

What Was the Status of the HSS System at the End of the Scenario?

As in previous workshops, the HSS systems in the UAs operated at or near capacity for most of the duration of the scenario. Surgical capabilities were the most taxed: UA Forward Surgical Teams (FSTs) performed 118 surgeries, totaling approximately 114 surgical hours, not including pre- or post-operative procedures. The medical demand, however, was not evenly distributed among the UAs, ranging from 18 to 46 cases among them. Not surprisingly, the FST that performed the most surgeries also experienced the greatest delay times from wounding to surgery. To handle surges in demand, the workshop SMEs carefully managed the triage of surgical patients in consideration of the austere surgical capability, often "bumping" patients in favor of others more critically wounded. This practice, enabled by remote triage capabilities, likely contributed to the elevated risk of limb loss, as a result of delayed surgery of vascular extremity wounds in favor of life-saving surgery for another casualty.

Evacuation assets were also used near capacity during the scenario. The dispersion of the battlefield and number and timing of casualties requiring evacuation and care contributed in some cases to long delays before a casualty reached surgery (for those requiring surgery); however, the surgical load also contributed to this delay, and it is difficult to determine precisely the contribution of evacuation asset availability.

How Many Casualties Required Further Evacuation and Treatment at Echelons Above the UA?

Similar to ATW IV, approximately two-thirds of casualties required evacuation to higher echelons. Of these, nearly 80 percent were classified as "urgent" or "priority," and approximately two-thirds would require surgery at echelons above the UA. Partially because of an early peak in the casualty flow in the scenario, the number of casualties requiring evacuation from the UAs similarly peaks early in the battle. This trend suggests the need for robust HSS capabilities at echelons above the UA fairly early in this scenario.

Workshop Observations and Conclusions

Observations

The complete effect of the casualties on the HSS system is not known at this juncture, because ATW V could examine the effect only on the UA system, given that the HSS system at higher echelons has yet to be fully developed. Similarly, it is important to note that the final disposition of those casualties who are awaiting evacuation to echelons above the UA is not completely certain. In the time beyond H+100 hours,[3] the percentage of DOW casualties likely will either remain the same or increase, given that some seriously wounded casualties awaiting evacuation could die during the wait. In other words, nearly two-thirds of the casualties were determined to be ready for evacuation to higher echelons, and their disposition will necessarily depend upon capabilities at those echelons.

This workshop was designed primarily to analyze the residual demand that multiple UAs will place on the echelons-above-UA HSS system for a specific scenario. Consequently, if a UA could not adequately deal with a casualty, it was assumed that the casualty would be evacuated to an echelons-above-UA HSS system component that could. The HSS system in the UAs was heavily taxed, and the residual demand for evacuation and care at higher echelons was similarly significant.

Conclusions

ATW V provided valuable insights into the ability of AMEDD's envisioned Future Force HSS system to support a Future Force operation. This workshop also continued the process, begun in ATW IV, of determining the demand that an echelons-above-UA HSS system will be required to meet in Future Force operations. Although the results and insights gleaned from ATW V are unique to a specific scenario and simulation, they do point to the potential medical challenges posed in supporting rapid Future Force operations on a highly dispersed battlefield.

The workshop also reinforced the importance of simulating Future Force concepts and the criticality of in-depth, subject matter expert analysis in assessing the outputs of any simulation. In the case of this workshop, every casualty generated by the simulation was tracked from the point of wounding through the UA HSS system by experts in all the components of combat casualty care. Thus, the teams were able to articulate credible casualty outcomes and the challenges facing emerging AMEDD concepts, structures, and technologies in supporting postulated Future Force operations. The team members stressed that further simulations of additional scenarios of evolving Future Force concepts are needed to ensure that the AMEDD can articulate to the Army the medical risks involved in those concepts and the ability of the future HSS system to mitigate those risks to a level acceptable to the Army. Such analysis will support the design and implementation of an HSS system capable of conserving the fighting strength of the Army's Future Force.

---

[3] The *DOD Dictionary of Military and Associated Terms* (Joint Doctrine Division, 2005) defines H-hour as "the specific hour on D-day at which a particular operation commences."

Acknowledgments

We gratefully acknowledge the assistance of all the participants in the workshop for their contributions to its success. We also are indebted to the RAND researchers who served as facilitators and analysts during the workshop: John Bondanella, Richard Darilek, Martin Libicki, Jennifer Moroney, Terri Tanielian, and Anny Wong. We want to express our appreciation to the RAND support staff, whose efforts once more enabled a smoothly functioning workshop. Kathryn Khamsi deserves a special thank-you for her expertise in compiling this report.

Abbreviations

AEF	Air Expeditionary Force
AMEDD	Army Medical Department
AMEDD C&S	AMEDD Center and School
AO	Area of Operations
ARFOR	Army Forces (Headquarters)
ATACMS	Army Tactical Missile System
ATW	AMEDD Transformation Workshop
BAS	Battalion Aid Station
BMIST	Battlefield Medical Information System Telemedicine
CASS	Center for AMEDD Strategic Studies
CFACC	Combined Force Air Component Command
CFLCC	Combined Forces Land Component Command
CLS	Combat Lifesaver
CSH	Combat Support Hospital
CSOTF	Combined Special Operations Task Force
CVBG	Carrier Vessel Battle Group
DEPMEDS	Deployable Medical System
DOW	Died of Wounds
EMT	Emergency Medical Treatment
EPW	enemy prisoner of war
FARP	Forward Area Rearm/Refuel Point
FCS	Future Combat System
FDDMTF	Forward-Deployable Digital Medical Treatment Facility
FSB	Forward Support Battalion
FST	Forward Surgical Team
FTTS-U	Future Tactical Truck Systems—Utility
FY	fiscal year
HBOC	Hemoglobin-Based Oxygen Carrier
HIMARS	High Mobility Artillery Rocket System

HSS	Health Service Support
ICU	Intensive Care Unit
ISR	Intelligence, Surveillance, and Reconnaissance
IV	Intravenous
JFMCC	Joint Force Maritime Component Command
KIA	Killed in Action
kph	kilometers per hour
LD	line of departure
LOC	Lines of Communication
LRRS	Long-Range Reconnaissance and Surveillance
MANPADS	Man-portable Air Defense System
MCO	Major Combat Operation
MI	Military Intelligence
MMR	Multi-Mission Radar
MRMC	[U.S. Army] Medical Research and Materiel Command
MV-E	Medical Vehicle—Evacuation
MV-T	Medical Vehicle—Treatment
OBJ	Objective
OFW	Objective Force Warrior
OPTEMPO	Operational Tempo
PA	Physician's Assistant
PAR	patients at risk
PDA	personal digital assistant
PL	Phase Line
RSTA	Reconnaissance, Surveillance, and Target Acquisition
RTD	Returned to Duty
SASO	Stability and Support Operation
SMART MC3T	Special Medical Augmentation Response Team for Medical Command, Control, Communications, and Telemedicine
SME	Subject Matter Expert
SSC	Smaller-scale Contingency
TAA	Tactical Assembly Area
TALSS	Transportable Automated Life Support System
TRAC	[U.S. Army] Training and Doctrine Command (TRADOC) Analysis Center
TRADOC	[U.S. Army] Training and Doctrine Command
UA	Unit of Action
UE	Unit of Employment (two types UE_x and UE_y)

VIC	Vector in Command
WIA	Wounded in Action
WIN-POC	Warfighter Information Network—Proof of Concept
WPSM	Warfighter Physiological Status Monitor

CHAPTER ONE

Introduction and Background

This report continues the task of documenting the Army Medical Department's (AMEDD's) process of identifying and addressing medical issues related to the Army's transformation to the Future Force. It describes the AMEDD Transformation Workshop (ATW) V, conducted at the RAND Corporation Washington Office 25–28 May 2004, and includes an analysis and discussion of the workshop results.

ATW V built upon the work of four previous workshops in assessing the medical risks associated with emerging Army operational concepts and the capacity of the AMEDD to mitigate these risks. Medical risk is defined generally as the number, severity, and fate of U.S. Army casualties incurred during combat operations. The focus of ATW V, however, was to continue the process begun in earlier ATWs of assessing the capacity of AMEDD to mitigate future medical risks. The workshop established the casualty demand data that must be addressed by the echelons above the Unit of Action (UA) Health Service Support (HSS) system. Thus, the principal purpose of ATW V was to provide analytical support to the AMEDD to assist it in designing the HSS system above the UA level.

ATW V used a similar methodology as the one used in ATWs I–IV, in that it tracked individual casualties[1] through the HSS system (Johnson and Cecchine, 2004 and 2005). ATWs I–III focused on medical risk in a UA within a theater that had a defined echelons-above-UA HSS system (a 44-bed Combat Support Hospital [CSH]). These ATWs served both as pilot tests for the ATW methodology and to provide an initial assessment of the proposed HSS system. After these initial ATWs, the AMEDD determined that a 44-bed CSH was inadequate to handle the medical demand produced by a single UA in those scenarios. Accordingly, ATW IV assessed the medical risk and demand on an echelons-above-UA HSS system from a single UA during a simulated 12-hour battle with 76 casualties and without any posited echelons-above-UA system. ATW V involved four UAs (and supporting unit of employment [UE] units) with 429 casualties over a 100-hour simulated battle. In ATWs IV and V, casualties were not tracked outside the UA. They were treated within the UA and either returned to duty (RTD) or became a demand on an echelons-above-UA HSS system. The principal objectives of ATW V were (1) to test findings of earlier ATWs with a more up-to-date and complete battle scenario, (2) to explore concerns from earlier ATWs about the HSS system's ability to prevent limb loss, and (3) to determine the aggregate medical demand that four UAs (and the Units of Employment [UE_x and UE_y] supporting forces operating in UA areas of operation) would generate that would be the responsibility of

[1] Technically, soldiers wounded or killed are known as *casualties.* They are referred to as *patients* once they have entered the medical system above the level of first responder (e.g., combat medic) care. For simplicity, we use the term *casualty* throughout this report.

an echelons-above-UA HSS system to meet. The results of ATWs IV and V will provide an analytical basis for designing echelons-above-UA HSS systems.

Background of AMEDD Transformation Efforts

The Army's transformation to the Future Force not only posits dramatically different equipment, it also envisions radically new ways of fighting. One aspect of future Army operations that is of particular importance is the employment of widely dispersed units moving rapidly around the battlefield. These operational concepts potentially pose significant challenges for the units that support the combat elements. In 1998, the AMEDD began an analytical effort to gain insight into the challenges for HSS posed by emerging Army transformation concepts. Over the next few years, AMEDD conducted two games and several workshops to provide further insights into how it could best support the Army as it transformed.

The RAND Corporation has been involved with the AMEDD transformation efforts since 1998, providing analytical support to the games and workshops and an assessment of the issues they raised. In 2002, the AMEDD Center and School (C&S) asked the RAND Corporation to develop an analytic process and to conduct workshops to support the assessment of the ability of envisioned HSS concepts to support Army Future Force operations.

Since that time, RAND has hosted a total of five such workshops. The process for each of these workshops was very similar; however, there were differences in the focus of the analyses. ATW I–III focused on the total in-theater HSS system, whereas ATWs IV and V focused solely on the HSS system within the UA. As such, ATWs I–III tracked casualties through the total in-theater HSS system, which included organic UA assets and a CSH at the UE level. However, ATWs IV and V tracked casualties only through the UA HSS system, because their purpose was to begin the process of estimating the demand that UE operations would place on the echelons-above-UA HSS system.

The first series of workshops, ATWs I–III, focused on assessing medical risk within a UA. ATW IV validated and refined the methodology developed during ATWs I–III. ATW IV also extended the assessment of medical risk, begun in ATWs I–III, by asking participants to address several issues identified by the AMEDD. The issue assessment results from ATW IV mirrored those from ATWs I–III and were again similar in ATW V (see Chapter Four).

ATW V Focus

ATW V was focused on determining the medical demand that a UE engagement would present to an echelons-above-UA HSS system. Casualties within four UAs, including UE_x and UE_y elements operating in UA areas, were treated within the UAs to the extent possible and, where appropriate, were identified as demands on an echelons-above-UA HSS system. ATW V participants did not specifically assess the issues from ATWs I–IV. Instead, they were asked to comment on the issues if ATW V results differed from those obtained in the earlier workshops. Again, ATW V continued the work of ATW IV in determining the casualty demand on an echelons-above-UA HSS system as a way to provide data to the AMEDD as it designs that system.

This report is organized into four main chapters. Following this brief introductory chapter, Chapter Two describes the workshop design, including its organization, objectives, and methodology. Chapter Three presents the results of the workshop deliberations with respect to the status of the HSS system within the UA at the end of the scenario and the medical demand that would be placed on echelons above the UA. Chapter Four provides our overall observations and conclusions based on the results of ATW V. The report also includes four appendixes, including a list of workshop participants, a detailed narrative of the scenario utilized, a description of medical technologies employed, and an excerpt from the casualty tracking worksheet used by workshop participants.

CHAPTER TWO

AMEDD Transformation Workshop V Design

This chapter provides an overview of the AMEDD Transformation Workshop V design, including the organization, scenario, sequence of events, objectives, and methodology.[1]

Organization

At the heart of the workshop organization (see Figure 2.1) were two teams of subject matter experts (SMEs). Each team examined a discrete set of approximately half of the casualties generated by the scenario. Each team functioned as a seminar and was supported by a RAND facilitator and two data collectors.[2] A control/administrative support cell provided overall workshop direction and answers to questions from the two teams. Finally, the RAND project leaders conducted an analysis of the workshop results.

Workshop Teams

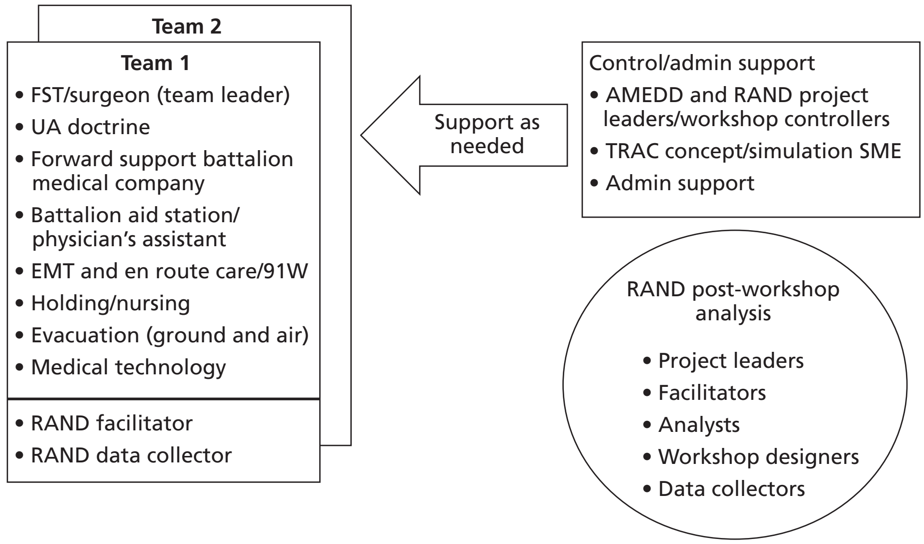
The two workshop teams each contained SMEs selected by the AMEDD. Their areas of expertise spanned the functional areas critical to an informed examination of a scenario focused on combat casualty care issues. These areas included Forward Surgical Team (FST) operations and trauma surgery; UA maneuver doctrine; forward support battalion medical company operations; battalion aid station and physician's assistant operations; medical holding and nursing; air and ground evacuation; and emergency medical treatment (EMT), en route care, and combat medics (91W). The teams deliberated to reach a consensus on how best to handle the casualty demand presented by the scenario and to determine the demand on an echelons-above-UA HSS system. The scenario used in the workshop was provided by the U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) and is discussed later in this report. Each team was headed by an AMEDD trauma physician and facilitated by a RAND analyst. Two RAND analysts also supported each team as data collectors. (See Appendix A for a list of ATW V participants.)

---

[1] The ATWs were designed as a modified version of "*The Day After . . .*" gaming methodology developed at RAND. Their goal was to present a team of experts with a structured problem to resolve by employing AMEDD's proposed future operational concepts and resources. For a description of the "*The Day After . . .*" methodology, see Anderson and Hearn, 1996.

[2] A seminar is defined in the *Oxford Desk Dictionary* as a "conference of specialists." This was as intended by the designers of the workshops, in contrast to the normal U.S. Army Training and Doctrine Command gaming methodology of having participants serve as role players.

Figure 2.1
AMEDD Transformation Workshop Organization



RAND *TR-302-2.1*

Control/Administrative Support Cell

The control/administrative support cell was the locus for workshop direction and other subject matter expertise. Specifically, it included representatives from the AMEDD, the TRADOC Analysis Center, and RAND.

Sequence of Events

Prior to ATW V, selected team members developed operational concepts for the scenario, including the allocation of HSS resources to meet the scenario requirements.

ATW V took place over a four-day period (25–28 May 2004) per the following schedule:

Day 1:

- Introductory briefings given in a plenary session.
- Team organization meeting in team rooms and start of deliberations and data collection.

Days 2–4:

- Team deliberations and data collection.

The teams self-organized to deal with the problem presented to them with the assets available. Most of the team members had experience in one or more of the previous ATWs. Therefore, they were familiar with the methodology, and team administrative and organizational issues took a minimum amount of time.

Workshop Objectives and Questions

Objectives

ATW V built on the work of ATWs I–IV and used a similar methodology (Johnson and Cecchine, 2004, pp. 16–19). The objective for ATW V was to examine postulated UA capabilities to provide combat casualty care during an operation. As with ATWs I–IV, each casualty was individually tracked through the HSS system. In ATWs IV and V, however, casualties were not tracked outside the UA. They were treated within the UA and either RTD or became a demand on an echelons-above-UA HSS system. Aside from assessing the performance of the UA HSS system, a principal focus of ATW V was on determining the residual medical demand that casualties from a full UE_x (four UAs and a supporting UE_y unit) would create and that would be the responsibility of an echelons-above-UA HSS system to address. Thus, ATW V built upon the analysis for ATW IV, which examined the casualties from a single UA. The results of these workshops will lead to identification of gaps between Army and AMEDD concepts and capabilities at the UA level. They will also provide an analytical basis for designing echelons-above-UA HSS systems.

ATW V used the results of a TRADOC Future Force UE simulation developed by TRAC (Ft. Leavenworth, Kansas). TRAC determined loss events from the simulation, and AMEDD determined resulting wounded-in-action (WIA) casualties. These data were used in ATW V to assess the adequacy of a postulated AMEDD HSS system designed to support the Future Force. HSS individuals, organizations, and capabilities were assumed throughout the workshop to operate optimally, i.e., they were assumed to always perform to standard and were not degraded by combat action or other means. In short, as with ATWs I–IV, an objective of ATW V was to assess the ability of the postulated Future Force HSS system, performing in "best case" modes, to support a Future Force operation.

Workshop Questions

At the conclusion of the workshop, each team was asked to provide answers to the following questions:

- What was the disposition of casualties (casualty outcomes) at the end of the scenario?
- What was the status of the HSS system at the end of the scenario?
- How many casualties required further evacuation and treatment at echelons above the UA?

Scenario

ATW V used the results from a TRADOC standard operational scenario (the Caspian 2.0 scenario). A detailed description of the scenario is in Appendix B. In this scenario, a smaller-scale contingency (SSC) situation required a strategic response to a distant immature theater. Coalition forces executed a stability and support operation (SASO) that escalated to a high-end SSC operation in which major combat operations (MCOs) were conducted. Upon the failure of deterrence of hostilities, the coalition intervened to restore a friendly government overthrown by a rebellious majority of its military.

In this scenario, Army Future Forces conducted operations as part of the main effort of the coalition force counteroffensive—decisive operations after a month-plus force buildup in theater. Army ground forces conducted operational maneuver, executing distributed and continuous operations in both open and rolling, and urban and other complex terrain.

The simulation that provided the basis for ATW V depicted Future Combat System (FCS)–equipped Maneuver UAs, operating as part of a UE_x and UE_y, conducting an attack to isolate the enemy's capital city and defeat enemy forces as part of the overall campaign objective of reinstating a legitimate government. The UE_y operated in a physical battlespace of over 500 kilometers by 225 kilometers.

The results of this simulation were the most currently available for ATW V. How representative they are of what might occur in future operations is unknown. The Army should conduct more simulations across different scenarios to validate and expand the utility of these outcomes for its force structuring and concept development efforts.

To support operations, each UA had the following HSS system resources (U.S. Army Armor Center, 2002):

- Combined Arms Platoon: One combat medic
- Combined Arms Battalion: One medical platoon with—
  - Treatment squad with two FCS Medical Vehicles—Treatment (MV-Ts)
  - Evacuation section with five FCS Medical Vehicles—Evacuation (MV-Es) (one initially positioned forward with each maneuver company in the battalion)
- Forward Support Battalion: One Medical Company with—
  - Treatment platoon with three MV-Ts
  - Evacuation Platoon with four MV-Es (one initially positioned forward with each Combined Arms Battalion) and four Future Tactical Truck System—Utility (FTTS-U) ambulances
  - Patient hold squad with the capability to hold up to 20 patients for 72 hours
  - Attached Forward Surgical Team capable of performing 30 resuscitative surgeries in 72 hours without resupply
  - Attached Forward Support Medevac Team with three HH-60L medevac helicopters
- UA Brigade Headquarters: 1 MV-T.

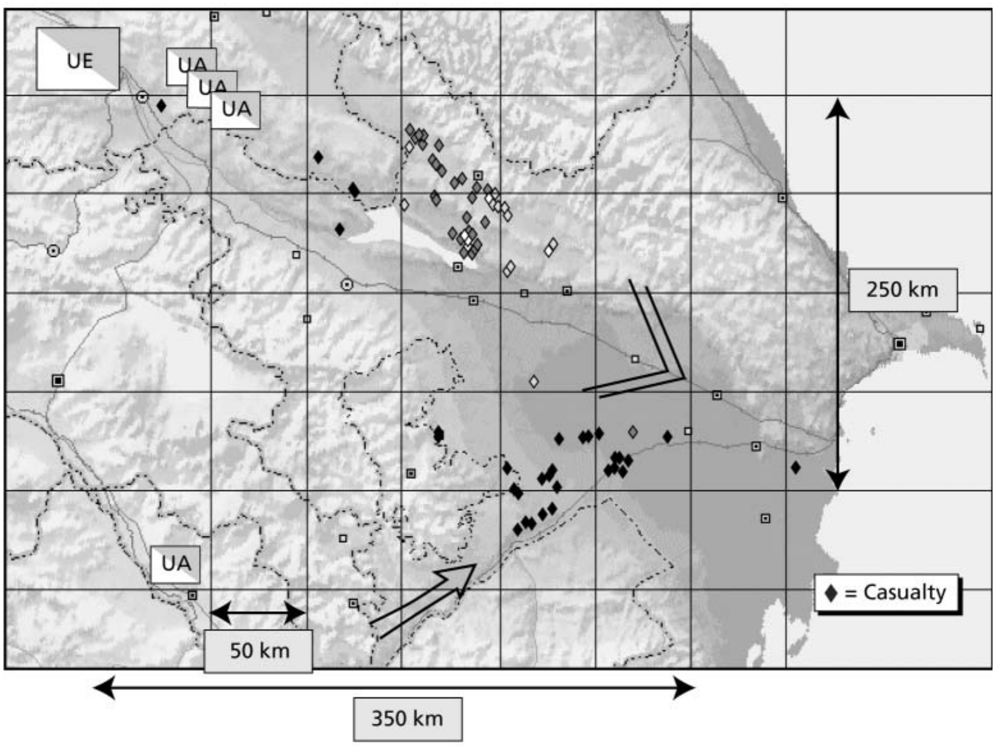
Additionally, each UA had an attached Forward Support Medevac Team with 3 UH-60L helicopters. At the outset of the workshop, the Forward Support Battalion (FSB) Medical Company SMEs task-organized the Forward Support Medevac Team helicopters to provide more support to the UA(s) most heavily engaged.

Throughout the workshop certain rules were observed to ensure the best possible performance of the envisioned HSS system. Specifically, none of the medical assets were degraded during the operation—e.g., no medics became casualties; no helicopters were shot down; and command, control, communications, computers, intelligence, surveillance, and reconnaissance systems worked perfectly. Additionally, there were no restrictions on medical materiel (Class VIII). Finally, 21 technologies deemed technologically feasible and due to be fielded by 2015 by the U.S. Army's Medical Research and Materiel Command (MRMC) were employed by the teams (see Appendix C).

Workshop teams were given casualty-tracking worksheets with the locations and times of wounding, Patient Condition Codes, and associated Treatment Briefs (see Appendix

D) to assist them in patient regulation and treatment.[3] The geographic distribution of casualties in the UE_x area of operations (AO) is shown in Figure 2.2. The FST in each UA remained fixed as the UA became engaged. As the battle progressed, the distance from the point of wounding to the FST generally increased in each UA. Additionally, although no echelons-above-UA HSS system locations were included in the workshop, one could logically assume that they would be fixed during the battle and located in the UE_x and/or UE_y rear areas. Thus, as the battle progressed, evacuation times within the UAs increased, causing significant challenges for timely evacuation. One could assume that these time and distance factors would also be a challenge in evacuating from the UAs to components of an echelons-above-UA HSS system.

Figure 2.2
UE_X Area of Operations and Casualty Distribution



NOTE: This figure is reproduced from an Army figure that supported the simulation used in ATW V. The diamond shapes designating casualties were colored in the original figure to denote their source; these colors are insignificant for this report.
RAND *TR-302-2.2*

---

3 Deployable Medical System (DEPMEDS) Patient Condition Codes describe a disease or injury. Treatment briefs provide an overview of the required medical treatment for each specific case.

Methodology

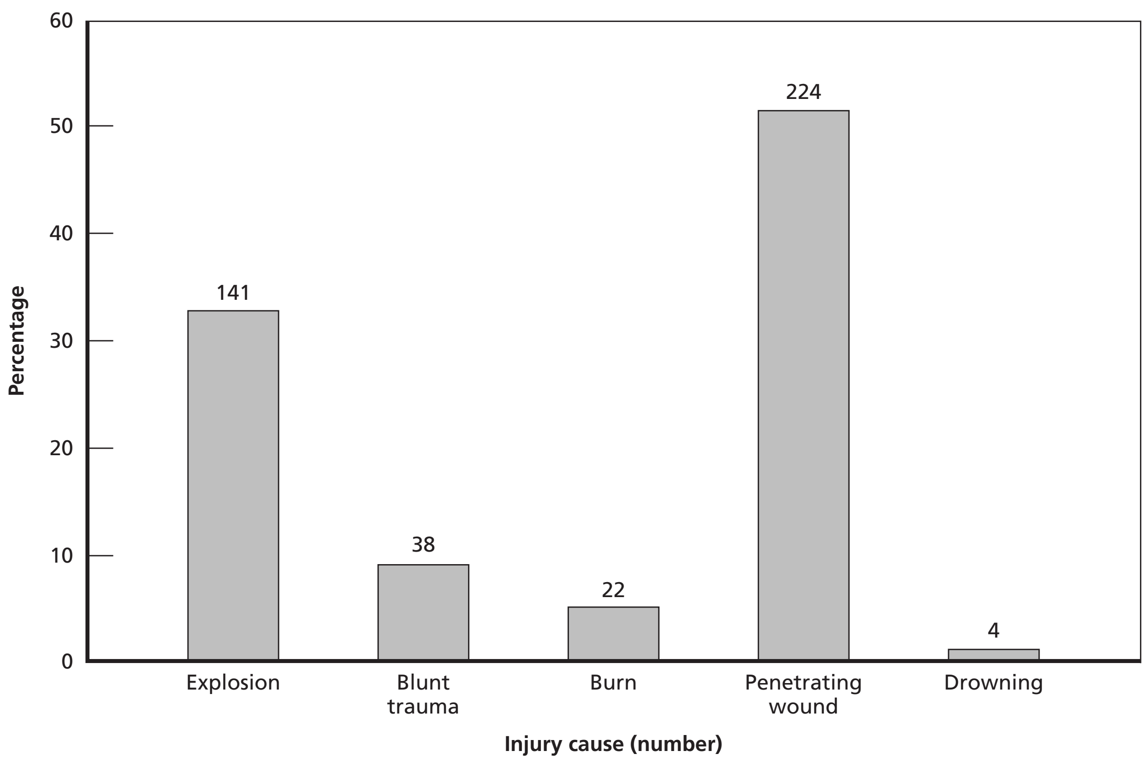
Casualty Data

Casualty data for ATW V was provided by the AMEDD, which derived it from simulation casualty data provided by TRAC. The Vector-in-Command (VIC) scenario generated 1,102 loss producing events that resulted in 429 WIA casualties during the approximately 100-hour battle, distributed among the four UAs and soldiers from the UE_x and UE_y in the UA AO. The AMEDD randomly distributed patient condition codes against the WIA casualties produced in the scenario; these codes included only combat casualty descriptions (i.e., not cases of disease). These codes are used contemporarily in Army medical planning and for medical force structuring. Figures 2.3 and 2.4 show the distributions of the casualty causes of injury and their wound types, respectively.

Determination of Casualty Outcomes

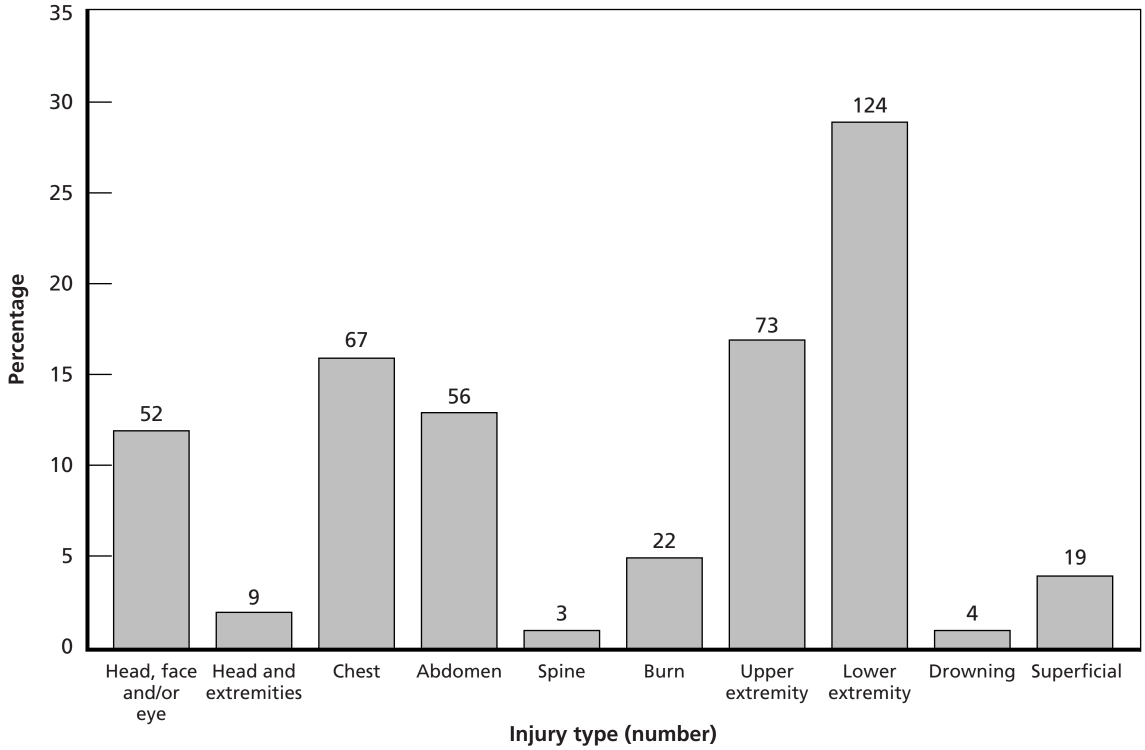
The participants of ATW V were charged with determining how to employ the UA HSS system to provide combat casualty care for the Future Force units modeled in the scenario and determining what residual of the casualty population would require HSS resources at echelons above the UA. The objective was for the SMEs to apply their collective expertise to determine the likely outcome for each casualty based on the decisions they would make on how to treat that casualty. The RAND facilitators and team leaders guided their teams in reaching

Figure 2.3
Causes of Injuries of 429 Casualties



RAND *TR-302-2.3*

Figure 2.4
Types of Injuries of 429 Casualties



RAND *TR-302-2.4*

a consensus solution for each casualty. Movement speeds were specified as: dismounted personnel, 3 kilometers per hour (kph); ground evacuation vehicles, 25 kph; and aerial evacuation (via UH-60Ls), 120 kph (no aerial evacuation was permitted forward of the company headquarters because of the surface-to-air missile threat).

The teams were provided data about casualties and available HSS resources. Specifically, they utilized the UA HSS organization, materiel, and operational concepts provided by the AMEDD Center and School. Additionally, the teams received casualty-tracking worksheets (see Appendix D) that provided a comprehensive listing of all casualties and included

- the time of wounding for each casualty
- the location of the casualty
- the location of the company headquarters, the battalion aid stations, and the medical companies/FSTs
- a description of the injury sustained by the casualty (a patient condition code).

The technologies employed in the scenario allowed for excellent situational awareness of incoming casualties to the HSS system. As such, the SMEs were presented with the entire casualty population at the beginning of the workshop. However, following medical doctrine and established medical triage procedures, the SMEs dealt with casualties in the order of their arrival. This process included applying triage procedures to casualties that arrived in close proximity to one another. In this manner, although the entire casualty population could be known to SMEs at the beginning of the scenario, they were evacuated and treated in the context of the scenario as they would be in the context of actual operations today: generally in the order they enter the HSS system. RAND facilitators and the members of a workshop control cell (including RAND and AMEDD study directors) ensured that SMEs regulated casualty evacuation and treatment in accordance with established doctrine as enabled by postulated future technologies.

Earlier ATWs established the effectiveness of the workshop methodology by comparing outcomes for the same casualties across workshop teams. Based on this experience, the fact that many ATW V SMEs had participated in earlier ATWs, and the large number of casualties to consider in ATW V, two SME teams examined different casualties. The casualties were divided between the teams by UA so that the HSS assets of a particular UA could be managed in isolation; i.e., decisions by one team had no effect on the other team's deliberations. In effect, each casualty was therefore considered only once.

The SMEs considered each casualty sequentially, in the order the soldier appeared in the scenario and as the casualty moved through the UA HSS organization provided by AMEDD C&S and based on the UA Operational and Organizational Plan.[4] The appropriate SME(s) deliberated on what type of treatment and evacuation was required and feasible at each stage of the casualties' progress through the HSS system, from combat lifesaver (CLS)/medic through the FSTs and UA medical companies. The SMEs annotated their actions, results, and observations in the appropriate columns of the casualty tracking worksheet. This methodology is depicted in Figure 2.5.[5]

Casualty Information: Distributions of Severity, Unit, and Timing

Doctrinally, a triaging process is used to classify and sort casualties at the point of wounding and at each level of care. This process is designed to ensure that the maximum benefit of care is provided to the population of patients as a whole, considering the available resources at the treatment location. The Warfighter Physiological Status Monitor (WPSM) technology employed in ATW V allowed for initial triage to be performed remotely, based on the patient condition code descriptions provided to the participants. This initial triage capability provides a reasonable estimation of the distribution of injury severities among all of the 429 casualties. This distribution is shown in Figure 2.6.

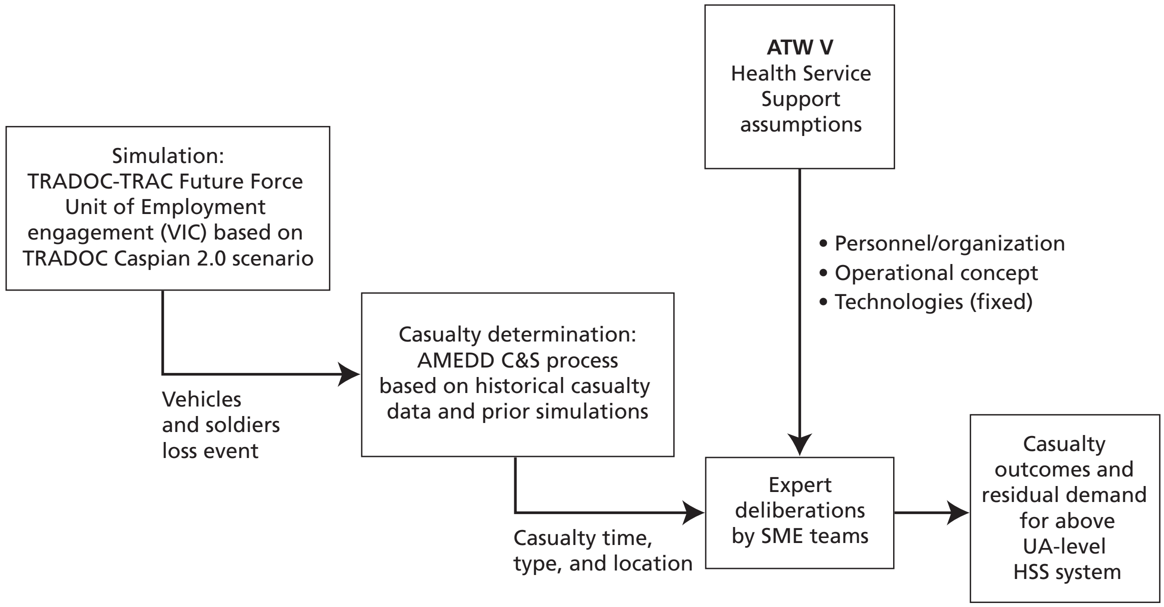
In Figure 2.6, "dead" refers to those casualties who died instantly as a result of the severity of their wounds. It should be noted that other casualties were also classified as dead after this initial triage because they died before entering the medical system but after receiving initial care at the point of wounding. In contrast, casualties who die after entering the medical system are classified as died of wounds (DOW) (see Chapter Three). The triage categories are defined as follows (U.S. Department of the Army, 2000):

---

[4] U.S. Department of the Army, Armor Center, 2002. Civilian and enemy prisoner of war casualties were not considered—they would surely increase the demand on the HSS system at the UA and at echelons above the UA.

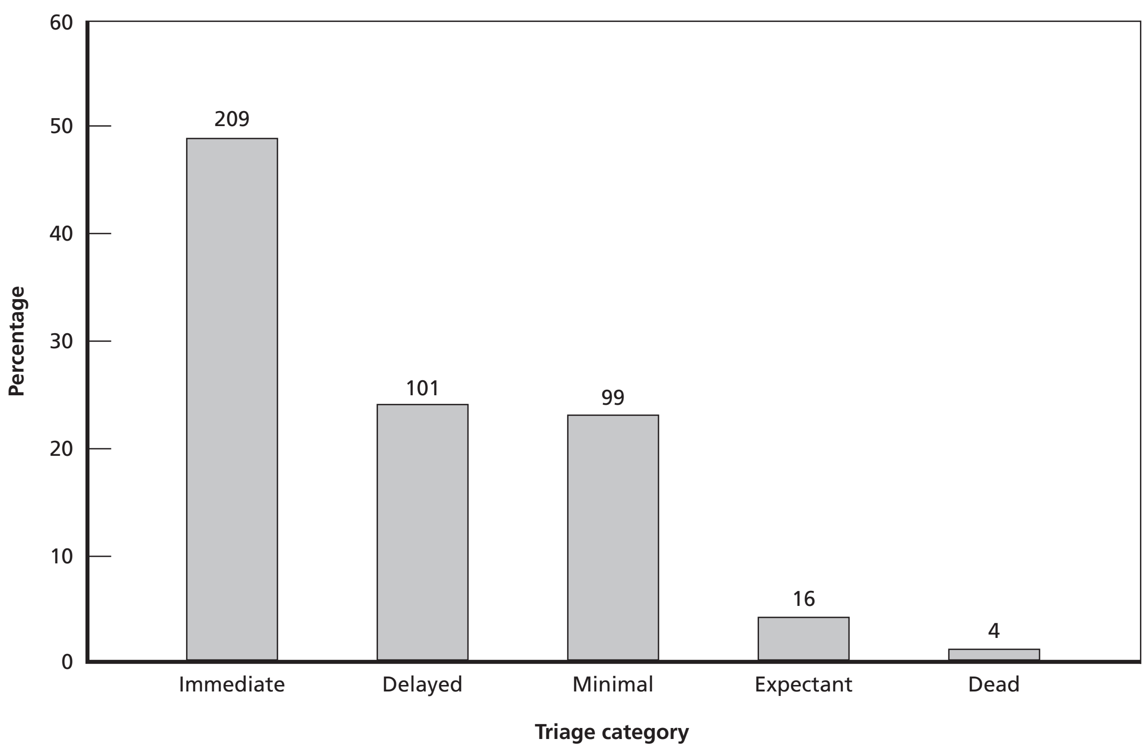
[5] In ATWs I–III, the workshop designers employed three teams, working on the same problem with identical resources, to validate the workshop methodology. Given the consistent results across these three teams (reported in Johnson and Cecchine, 2004), the workshop designers reduced the number of teams to two. ATW IV results were consistent between the two teams, further assuring the validity of the methodology. This decision to use two, instead of three, teams eased the demand on the AMEDD to provide SMEs during a period of high operational tempo without jeopardizing results. In ATW V, two teams each assessed approximately one-half of the total casualties.

Figure 2.5
Methodology for the AMEDD Transformation Workshops



RAND *TR-302-2.5*

Figure 2.6
Initial Triage Classification of 429 Casualties as Determined by Workshop Participants Based on Remote Triage Capability



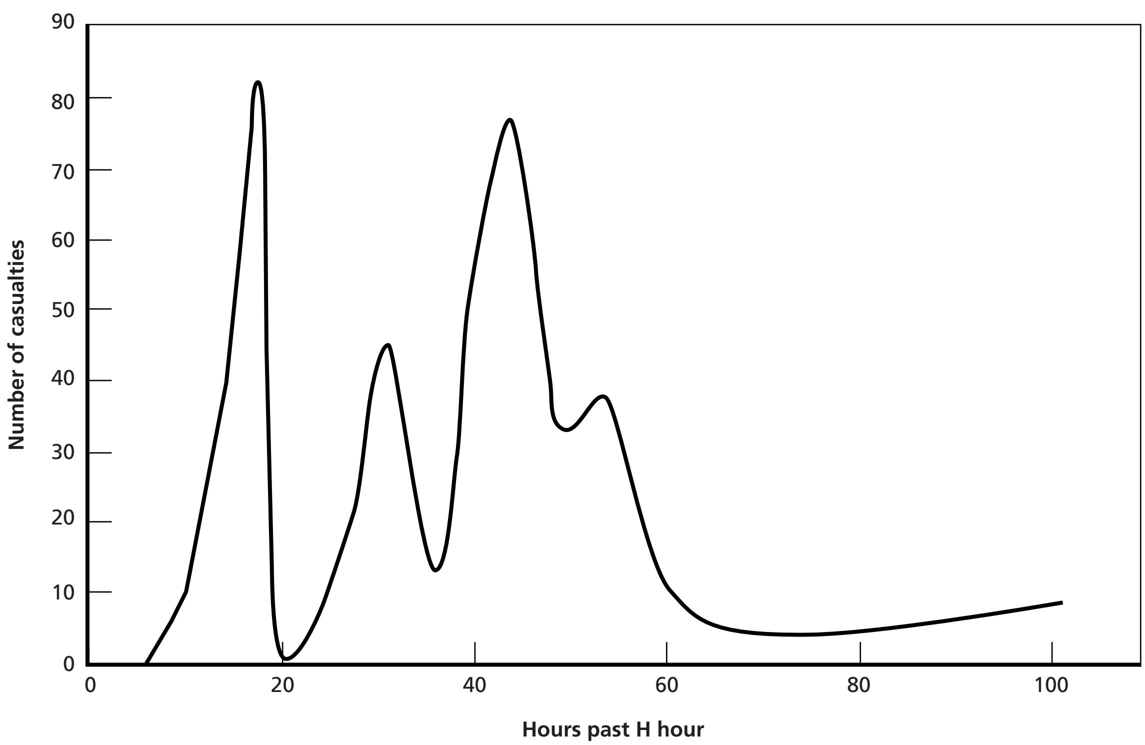
RAND *TR-302-2.6*

- Immediate—patients requiring immediate care to save life or limb.
- Delayed—patients who incur little additional risk from delaying further treatment after receiving immediate care.
- Minimal—patients requiring little care and who can normally be expected to return to duty.
- Expectant—patients so critically injured that only complicated and prolonged treatment will improve life expectancy.

The triage process is dynamic: A casualty who might not survive far-forward on the battlefield, given the ability and resources of a medic providing initial care, may have a better chance of survival at more robust levels of care. Therefore, that casualty's triage category may be different in those different situations and locations. In the case of ATW V, initial triage categories were assigned based on the capabilities at the point of wounding. This methodology allowed for a fundamental assessment of the distribution of casualties to be dealt with during the workshop. Wound severities were also assigned to casualties by the medical SMEs; these severities were primarily used to classify the types of casualties that would require care at echelons above the UA. Triage classifications are more commonly understood and used doctrinally by the military medical community; because of their dynamic nature, they were used to provide an initial classification within a UA, but wound severity was used as a more static estimation of demand at higher echelons (see Chapter Three).

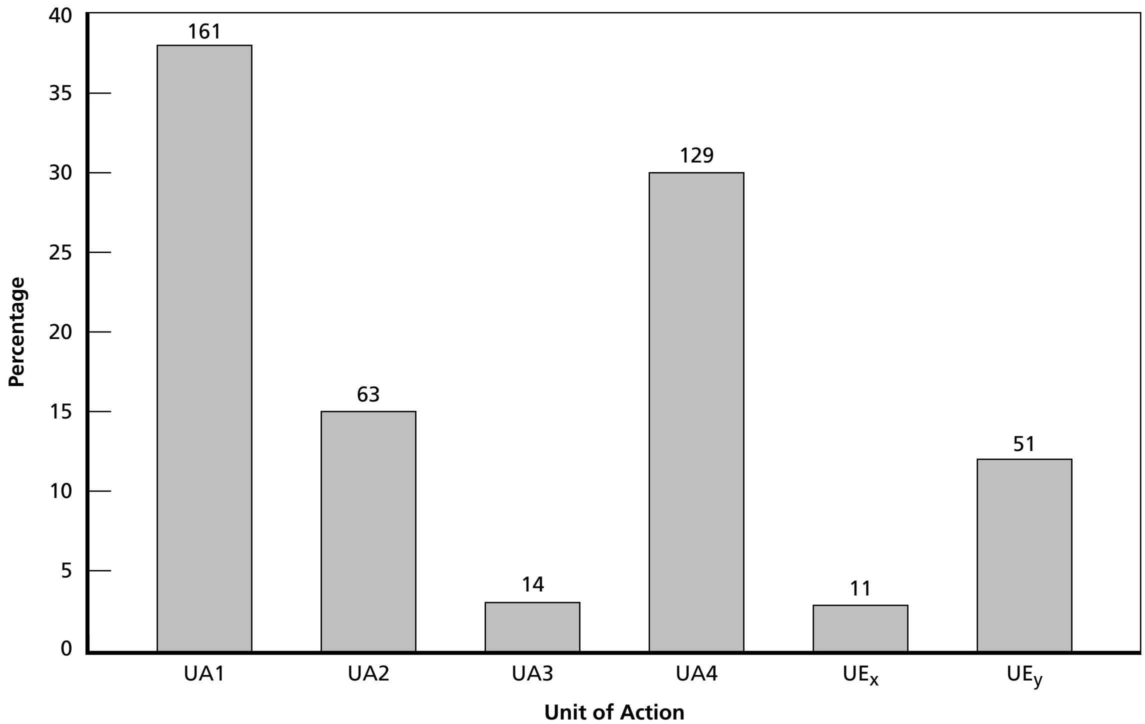
The 429 casualties in ATW V were not incurred at a steady rate over time, nor were they evenly distributed among the UAs, as shown in Figures 2.7 and 2.8.

Figure 2.7
Representation of Casualty Distribution Over Time



RAND *TR-302-2.7*

Figure 2.8
Distribution of Casualties by UA



RAND *TR-302-2.8*

Figure 2.7 shows that the casualty flow was not uniformly distributed over time. This is a reasonable expectation and generally has been the case historically, as casualties are incurred in clusters based on sporadic events throughout a campaign, such as firefights.

Although the overall production of casualties is non-continuous, this figure represents the casualty flow with a smoothed trend line to give an impression of the times of peak casualty production; figures later in this report (e.g., in Chapter Three) provide more precise times for casualty events to best characterize the medical demand on echelons above the UA. Significant for ATW V is an early peak in the flow of casualties that presented challenges for the HSS system in accommodating later casualties with limited resources. Figure 2.7 also includes UE_x and UE_y casualties that were treated by the various UAs. Guidance to the ATW V teams was that these casualties would be treated by the UA within whose AO they occurred. Figure 2.8 shows the distribution of casualties across the UAs and from echelons above the UAs that occurred within UA AOs.

CHAPTER THREE

Workshop Results

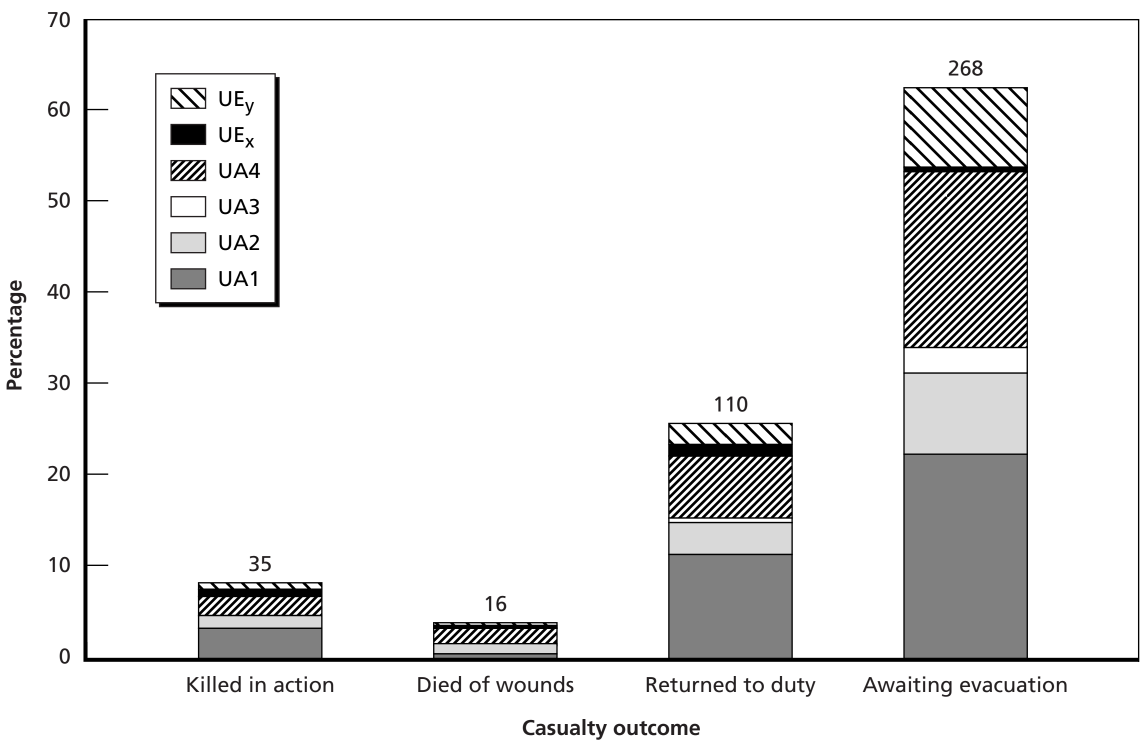
Health Service Support Within the Unit of Action

Total Casualty Outcomes

The scenario generated 429 casualties during the approximately 100-hour battle. The causes, types, and timing of these casualties were described in Chapter Two. Figure 3.1 shows the outcomes of these casualties as estimated by the workshop SMEs.

While Figure 3.1 accounts for all of the casualties incurred during the simulation, it is important to note that the final disposition of those casualties who are awaiting evacuation

Figure 3.1
Casualty Outcomes for 429 Casualties by Unit of Action, ATW V



RAND *TR-302-3.1*

to echelons above the UA is not completely certain. In the time beyond H+100 hours,[1] the percentage of DOW casualties will either remain the same or increase, as some seriously wounded casualties awaiting evacuation could die. In other words, nearly two-thirds of the casualties were determined to require evacuation to higher echelons, and their disposition will necessarily depend upon capabilities at those echelons. The utilization of UA surgical assets is discussed further in the next section.

It is therefore difficult to determine the final disposition of casualties awaiting evacuation, because the capabilities of a future echelons-above-UA HSS system have yet to be determined; however, this methodology provides a realistic estimate of the demand upon the higher echelons given the HSS assets available in the UA. Specifically, casualties determined to require evacuation from the UA were "set aside" immediately upon that determination. Some of these casualties required stabilization within the UA prior to this designation; if that care was unavailable, the casualty's prognosis was updated. However, after being designated as requiring evacuation from the UA, it was assumed that a casualty was evacuated immediately, and additional required stabilization care was not counted against UA HSS assets. This methodology was used to provide an estimate of the demand for medical support at echelons above the UA while also testing the capacity of support within the UA under optimal circumstances (as discussed in Chapter Two). In essence, this approach postulates an echelons-above-UA HSS system with infinite capacity; estimating the demand to be met by such a system was a primary goal of this workshop.

The rates of casualties who DOW and who died prior to reaching a medical treatment facility (killed in action [KIA]) in ATW V were similar to those in previous workshops, even though they were based on different scenarios (Johnson and Cecchine, 2004 and 2005). Similarly, the previous workshop (ATW IV) also resulted in an estimation of approximately two-thirds of casualties requiring evacuation to echelons above the UA. A reasonable explanation for these similarities is based on a combination of three factors evident in the scenarios used in ATWs I–V: (1) the dispersion and distance characterized by Future Force operations, (2) a UA HSS system structure that operates at or near capacity in support of those operations, and (3) similar (and plausible) estimations of casualty distributions based on the simulations.

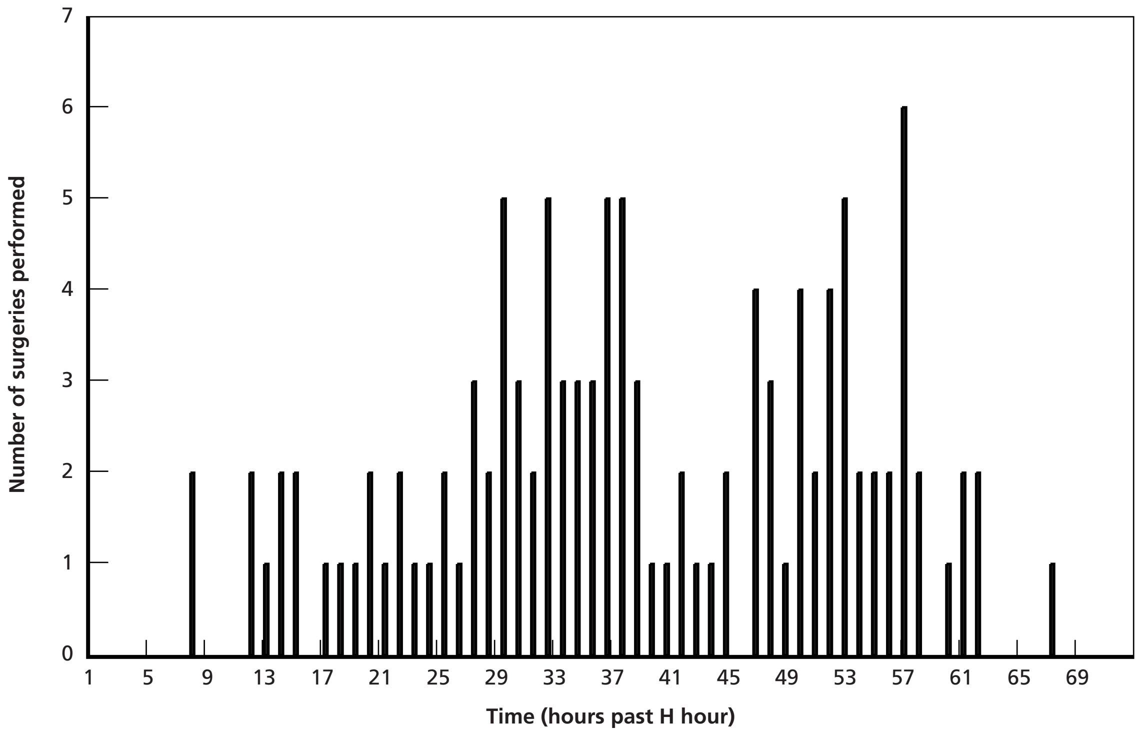
Demand on Forward Surgical Teams

Earlier workshops reported on the performance of the HSS system within the UA. While this workshop focused on estimating demand for higher echelons, it also provided some, more limited, information about UA HSS performance. In short, the UA medical assets were operated at or near capacity throughout the simulation and were overwhelmed in some cases. For example, data collected in this workshop provided information about the operational tempo of FSTs in the UAs. The number and timing of surgeries performed are shown in Figure 3.2.

The UA FSTs performed 118 surgeries totaling approximately 114 surgical hours, not including pre- or post-operative procedures. The medical demand, however, was not

[1] The *DOD Dictionary of Military and Associated Terms* (Joint Doctrine Division, 2005) defines H-hour as "the specific hour on D-day at which a particular operation commences."

Figure 3.2
Distribution of All Surgeries Performed (118 Total) at UA FSTs by Starting Time of Each Surgery, ATW V



RAND *TR-302-3.2*

evenly distributed among the UAs (see Figure 2.8) or over time (see Figure 3.3). The number of surgical cases per FST ranged from 18 in UA2 to 46 in UA4.[2] Figure 3.3 shows the number of surgeries performed and the time that each FST was operating at surgical capacity; i.e., performing surgery on two patients.

Considering the non-continuous casualty flow (see Figure 2.7), one can infer that the distribution of times that surgeries were required, as opposed to when they were actually performed, was even more compressed during peak casualty times. The result was that the workshop SMEs had to carefully triage patients requiring surgery and manage the order of surgeries performed. This approach often resulted in some patients who required surgery being "bumped" from the surgical queue in favor of more seriously wounded casualties. One consequence of this necessary management of high-demand resources was that some casualties suffered limb loss because they were bumped in order to save the life of another casualty, resulting in an additional life saved at the cost of an amputation.

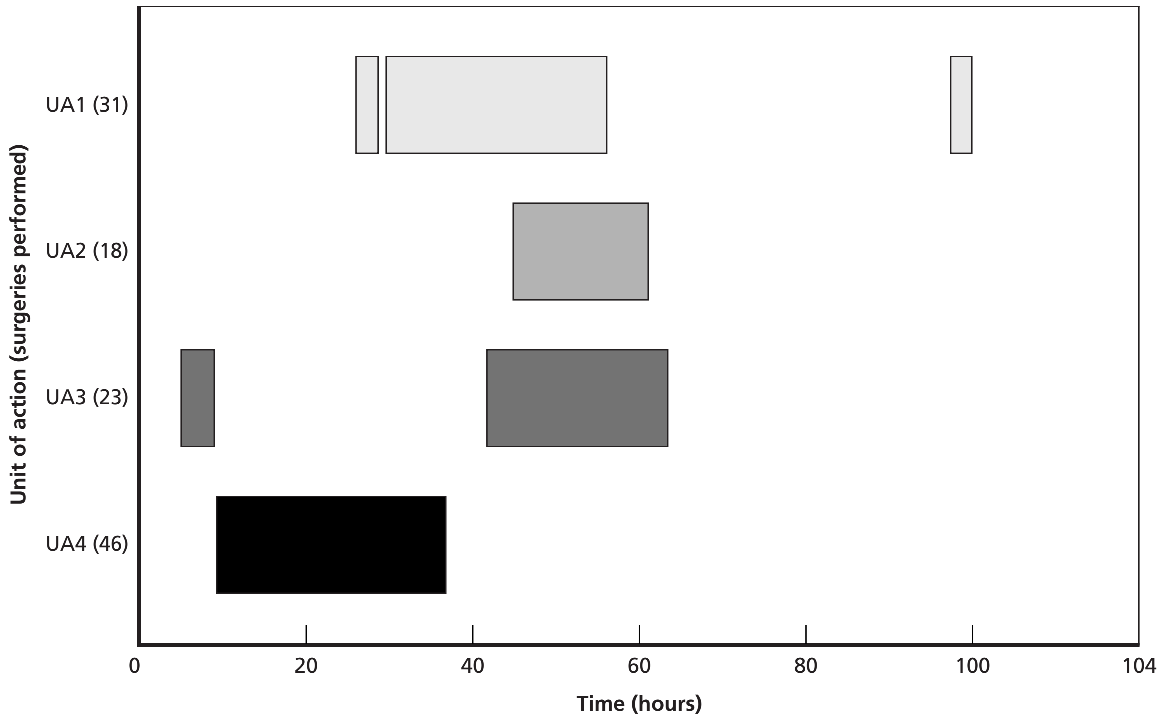
Limb Loss Estimates

Estimations of casualties who would suffer limb loss were higher in this workshop in comparison with earlier workshops. In some respects, this comparative increase is likely an arti-

---

[2] As discussed in the following chapter, distributing surgical cases among FSTs (providing lateral support between UAs) was not possible.

Figure 3.3
Time Periods When FSTs Were at Maximum Capacity



RAND *TR-302-3.3*

fact of the workshop design: Concerned about putative estimations of limb loss in earlier workshops, we made some design changes in this workshop to explicitly capture information about limb loss. While this artifact may have contributed to an increase in limb loss estimates over previous workshops, it did not distort the assessment in this workshop. SMEs were confident (and alarmed) that the limb loss estimation presented here is a realistic prediction of casualty outcomes in the scenario.

Limb loss estimates also include those cases in which medical SMEs predicted a *high* probability of limb loss following evacuation and treatment at echelons above the UA. Limb loss occurred in 58 casualties, representing 13.5 percent of all casualties. It is important to note that 106 casualties (25 percent of all casualties) had patient condition codes indicating that the casualty had a wounded, but salvageable limb. In contrast, 36 other casualties (8 percent of all casualties) had patient condition codes indicating that a limb was not salvageable. In some cases, the opinion of the surgical SMEs differed from the patient condition code determination of whether or not a limb was salvageable; in most cases this difference stemmed from the estimated benefit of future technologies that were not considered when the patient condition codes were created. Nonetheless, if one assumes that limb loss was not preventable in 36 of the 58 amputee casualties, limb loss did occur in 22 casualties described as having a salvageable limb injury.

Significantly, some of these 58 limb losses were likely unpreventable, based on the patient condition code. Considering outcomes for all casualties who lost a limb whether their limb wounds were described as salvageable or not, 21.6 percent of casualties who did not die and were not RTD either suffered an amputation or were likely to do so.

Of greater significance, however, are the 22 casualties who lost limbs even though they were described as having salvageable wounds (even without the application of advanced technologies). In other words, 21 percent of all casualties described as having a salvageable limb wound were still estimated to suffer an amputation. This represents limb loss among 8 percent of all casualties who did not die and were not RTD, and 38 percent of the estimated total 58 limb loss events. Furthermore, these prognoses were made assuming a best-case scenario: that a casualty would be evacuated to higher echelons as soon as ready (i.e., an infinite capacity at echelons above UA). In this respect, it is likely that actual limb loss *in this scenario* would be higher than estimated here if delays occur in evacuation.

One likely reason for these rates of limb loss was surgical capacity: Casualties who were delayed in the surgical queue in order to save another's life through surgery may have suffered limb loss as a result. Another plausible explanation is the delay in time from wounding to surgery—casualties with vascular extremity injuries often require prompt surgery to save the limb. This possibility is examined in the next section.

Delays from Time of Wounding to Surgery

The period of time following injury within which a significant number of serious trauma casualties will die without surgical intervention is often referred to as the "golden hour." The delay from wounding to surgery is a function of both evacuation times and the surgical workload. Furthermore, it should be noted that the term golden hour is more appropriate when discussing the timing of resuscitative care for blunt-trauma victims and does not accurately convey the urgency of care required for penetrating trauma, which is more characteristic of combat casualties (see Bellamy, 1995, pp. 1–42). However, since this term is commonly used, we used one hour as a standard of measure.

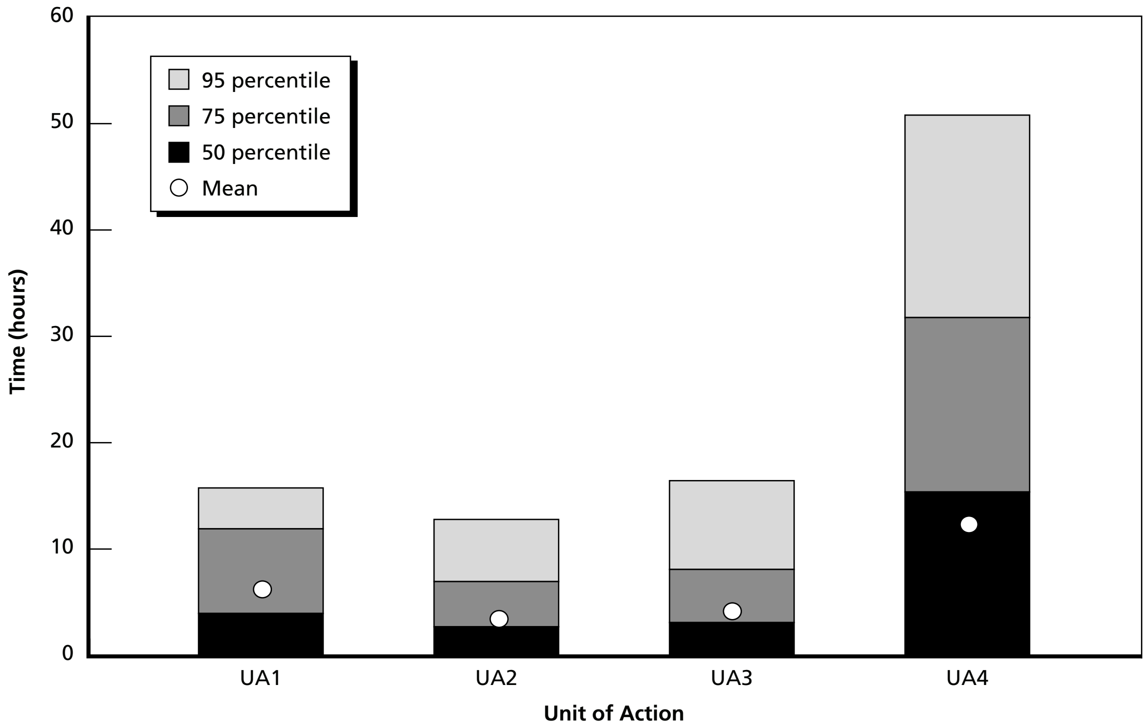
Delay times from wounding to surgery were longer in ATW V than in ATW IV. It was estimated in ATW IV that the one-hour standard was exceeded in all 29 surgical cases,[3] with a mean delay time of 2.7 hours. In ATW V, the mean delay time from wounding to surgery at an FST for those 118 casualties requiring surgery was 7.5 hours. Some possible explanations for this difference are the early peaks in casualty flow, more casualties overall, and high demand on the FSTs during the ATW V scenario, resulting in surgical backlogs. The times that each FST was operating at maximum surgical capacity during ATW V is shown in Figure 3.3. Figure 3.4 similarly compares delay times from wounding to surgery at each of the FSTs for those 118 total casualties requiring surgery. This figure distributes the delay times by percentiles, showing that the data are skewed toward longer delay times.

Not surprisingly, Figure 3.4 shows that delay times from wounding to surgery for those patients requiring surgery were longest in UA4, which performed the most surgeries. These results suggest that the backlog of surgical cases in that UA contributed to the delay time.

It may be hypothesized that casualties who experience a longer delay to surgery are more likely to suffer limb loss. The data do not support this hypothesis. There is no significant difference in the mean delay from wounding to surgery when comparing casualties who ultimately suffered limb loss with those also received surgery but did not lose a limb (t-test:

[3] In ATW IV, two teams deliberated on the same UA operation. One team estimated 15 surgeries and the other estimated 14 surgeries, totaling 29. There was no significant difference in the mean delay times estimated by the two teams.

Figure 3.4
Delay Time from Wounding to Surgery



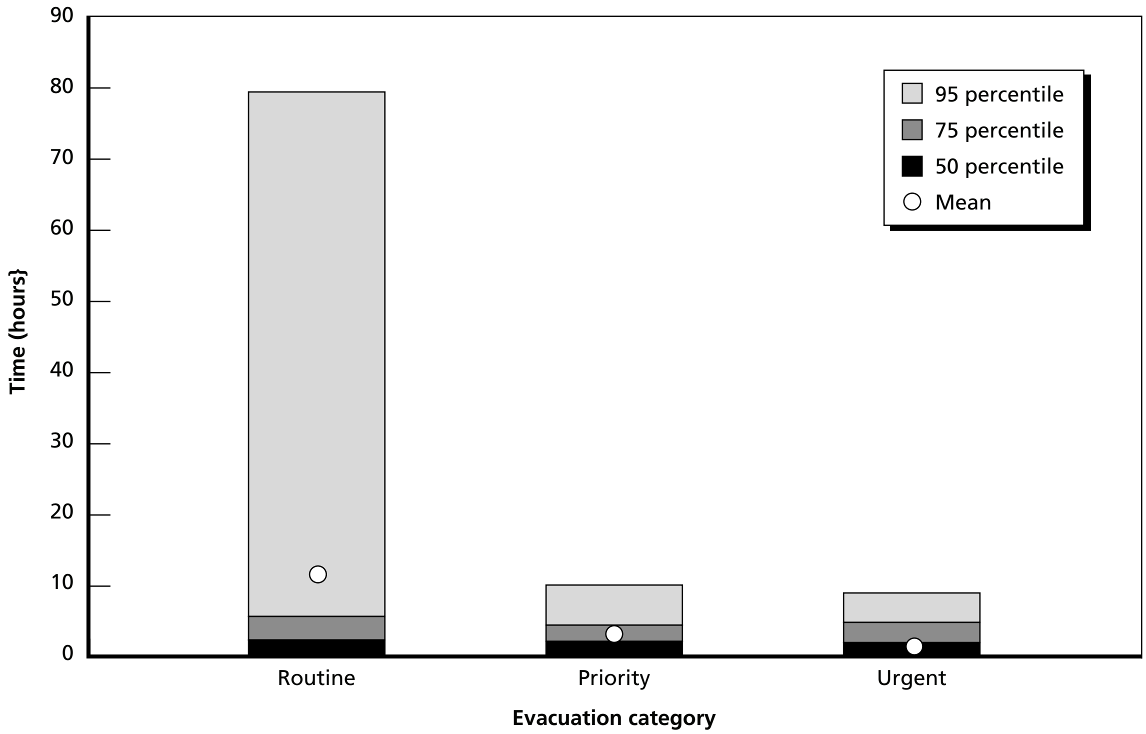
RAND *TR-302-3.4*

t-value = 0.35, p = 0.73). It is unclear why this is the case in this scenario, but it is possibly either because of the effects of triage (e.g., seriously wounded casualties were also at greater risk for limb loss and therefore operated on earlier) or because the mean delay time was sufficiently high that the detrimental effect exceeded some threshold for both groups, or a combination of the two.

Delays from Time of Wounding to Preparedness for Evacuation from the UA

Another delay time that informs an assessment of the UA HSS system performance and provides more information about the types and timing of casualties who will require treatment at echelons above the UA is the time from wounding to the time when a casualty is determined to be ready for evacuation from the UA. This delay time applies to those casualties who did not receive surgery in the UA and who were not KIA, DOW, or RTD in the UA. This measure provides some idea of how well the UA HSS system was able to clear the battlefield and stabilize casualties for further evacuation, while also performing surgery on other casualties who required it. Of 268 total casualties requiring evacuation to echelons above the UA (that is, not RTD, KIA, or DOW in the UA), 118 received surgery in the UA, leaving 150 casualties who did not receive surgery in the UA but who required further evacuation. Examining this group of casualties can provide some indication about the effectiveness of evacuation within the UA, since their progression from point of wounding to the UA rear boundary was not delayed by surgery. Figure 3.5 shows the delay time from wounding until casualties were marked as ready for evacuation from the UA for those 150 casualties who did

Figure 3.5
Delay Time from Wounding to Evacuation from the Unit of Action



RAND *TR-302-3.5*

not require surgery in the UA. Like Figure 3.4, it shows the distribution of delay times by percentile. It is divided by the evacuation category assigned when each casualty was determined to be prepared for evacuation from the UA.

Not surprisingly, the delay time was longer for routine casualties, who can survive a longer delay. Some less-severe (routine evacuation category) casualties were intentionally held at the UA until the end of combat operations, increasing the proportion of these casualties with a long delay time. This indicates that triage decisions regarding evacuation were appropriate; however, the upper tails of the distribution for priority and urgent casualties approached five hours, and the mean delay time for these sets of casualties was 3.7 and 2.4 hours, respectively. Because casualties marked for evacuation from the UA were assumed to be evacuated immediately, these data indicate that the long lines of evacuation and limited evacuation assets within the UA contributed to these delay times. While the average delay times for priority and urgent casualties were close to those dictated by doctrine (4 and 2 hours, respectively), the delay times were skewed toward longer time periods.

It is unclear why patients whose wounds required urgent attention would not be ready for evacuation significantly earlier. Again, the large number of casualties and their non-continuous presentation to a system that dealt with them sequentially and the practice of holding routine patients in the UA much longer are likely reasons. Also, more time is likely spent on life-saving care for urgent casualties, adding to their overall evacuation delay time. The time when casualties are prepared for evacuation to echelons above the UA can be an important consideration when determining what assets will be required at those higher echelons and when; this issue is discussed in more detail later in this chapter.

Treatment by Combat Medics and Combat Lifesavers

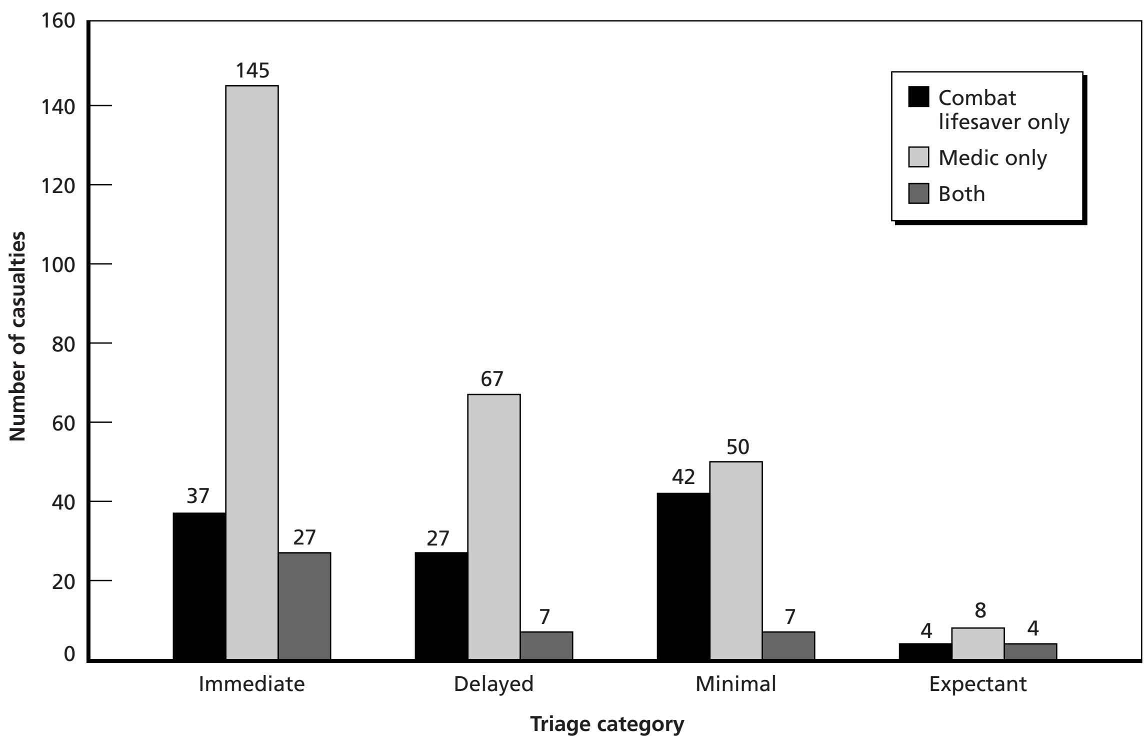
Combat lifesavers were involved in the treatment of 156 casualties (36 percent of all casualties). The comparison of initial triage categories for casualties treated by CLS and medics is presented in Figure 3.6, while the types of casualties and their outcomes are shown in Figures 3.7 and 3.8.

CLS and medics returned casualties to duty in equal numbers. Not surprisingly, it appears that medics were designated as the first care providers for the most severely wounded casualties, depending on their proximity to the casualties, because of their greater skills.

Medical Demand on Echelons Above the Unit of Action

While ATW V provided some observations about the performance of the HSS system within the UAs for this scenario, the primary objective of the workshop was to estimate the medical demand that would need to be met by echelons above the UA for this scenario. Figure 3.9 shows the total number of casualties that required evacuation to and/or treatment at echelons above the UA.

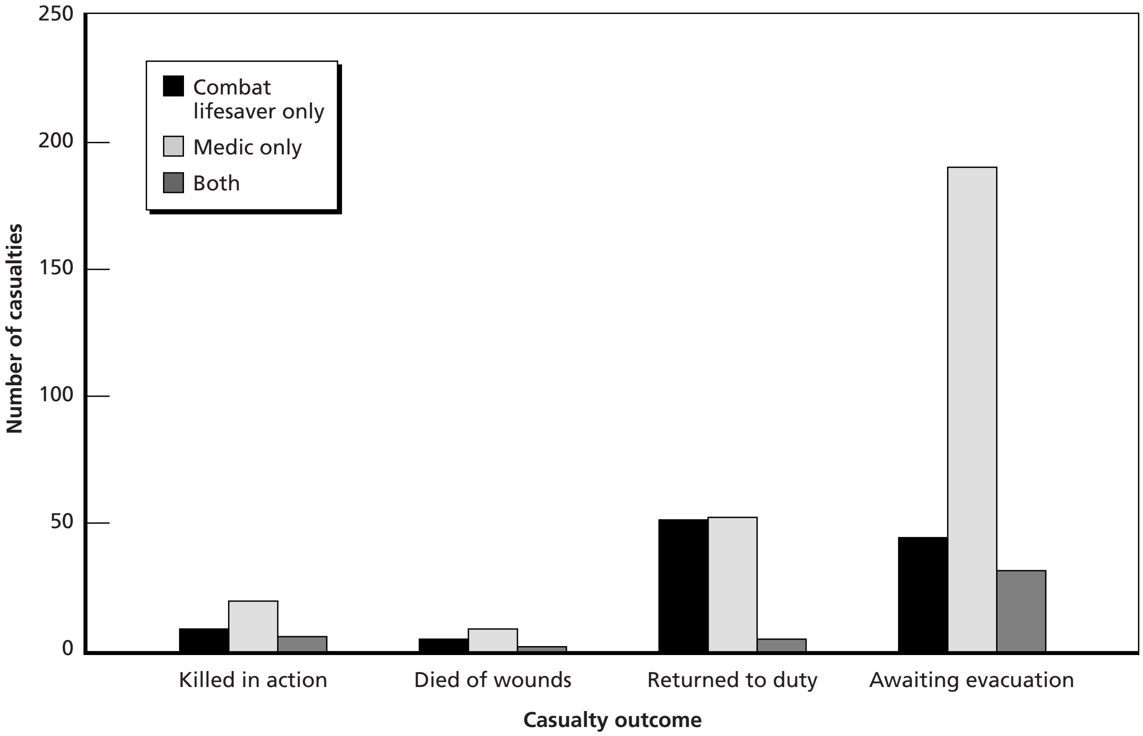
Figure 3.6
Comparison of Initial Triage Categories for 425 Casualties Treated by Combat Lifesavers or Combat Medics



RAND *TR-302-3.6*

NOTE: Four casualties who were killed immediately are not included.

Figure 3.7
Comparison of Outcomes for 429 Casualties Treated by Combat Lifesavers or Combat Medics



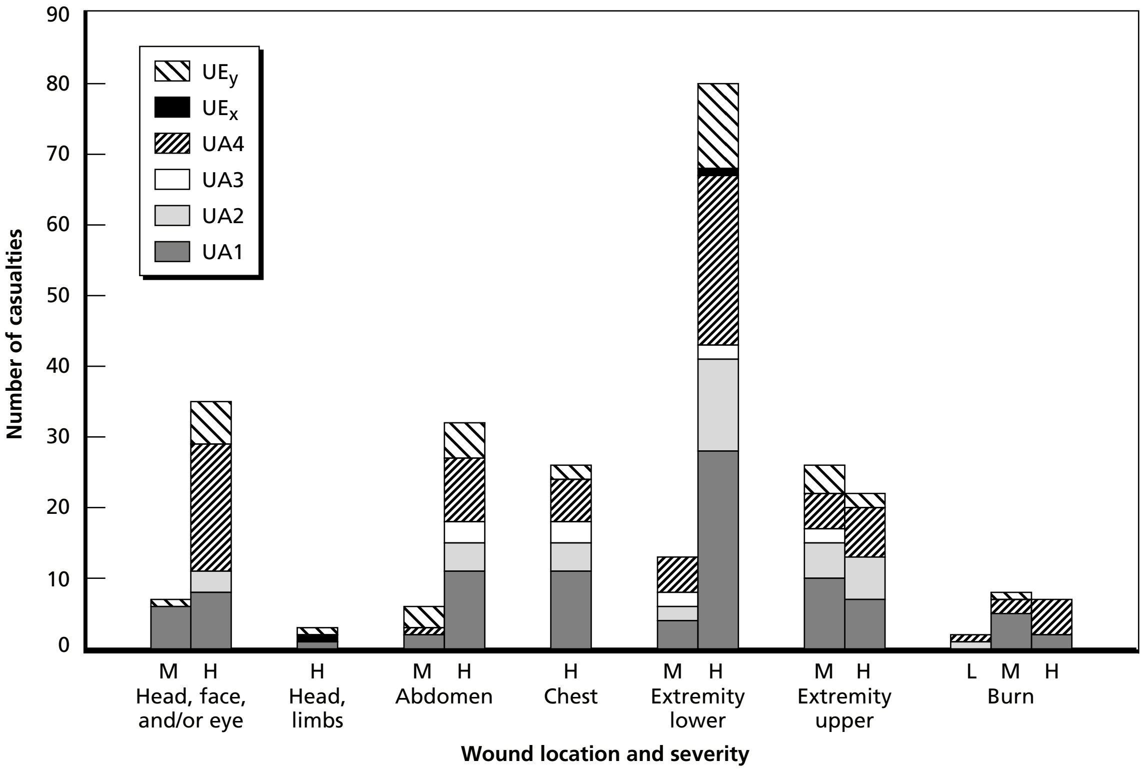
RAND *TR-302-3.7*

The evacuation categories shown in Figure 3.9 are as follows (U.S. Department of the Army, 2000, p. 7-2):

- *Routine.* Should be evacuated within 24 hours: casualties whose conditions are not expected to deteriorate significantly.
- *Priority.* Should be evacuated within four hours: casualties whose conditions could deteriorate to such a degree that they will become urgent casualties, whose requirements for special treatment are not available locally, or who will suffer unnecessary pain or disability.
- *Urgent.* Should be evacuated as soon as possible and within a maximum of two hours to save life, limb, or eyesight, or to avoid permanent disability.

Figure 3.9 also shows those patients who require intensive care (at an ICU) at echelons above the UA, those requiring surgery at echelons above the UA, and those requiring both intensive care and surgery at echelons above the UA. ICU and surgical casualties are subcategories; that is, they are also assigned an evacuation category and, therefore, should not be summed with the other categories to obtain the total of 268 casualties requiring evacuation.

Figure 3.8
Number of Casualties Requiring Evacuation to and Treatment at Echelons Above the UA, by Wound Location and Severity (268 total)



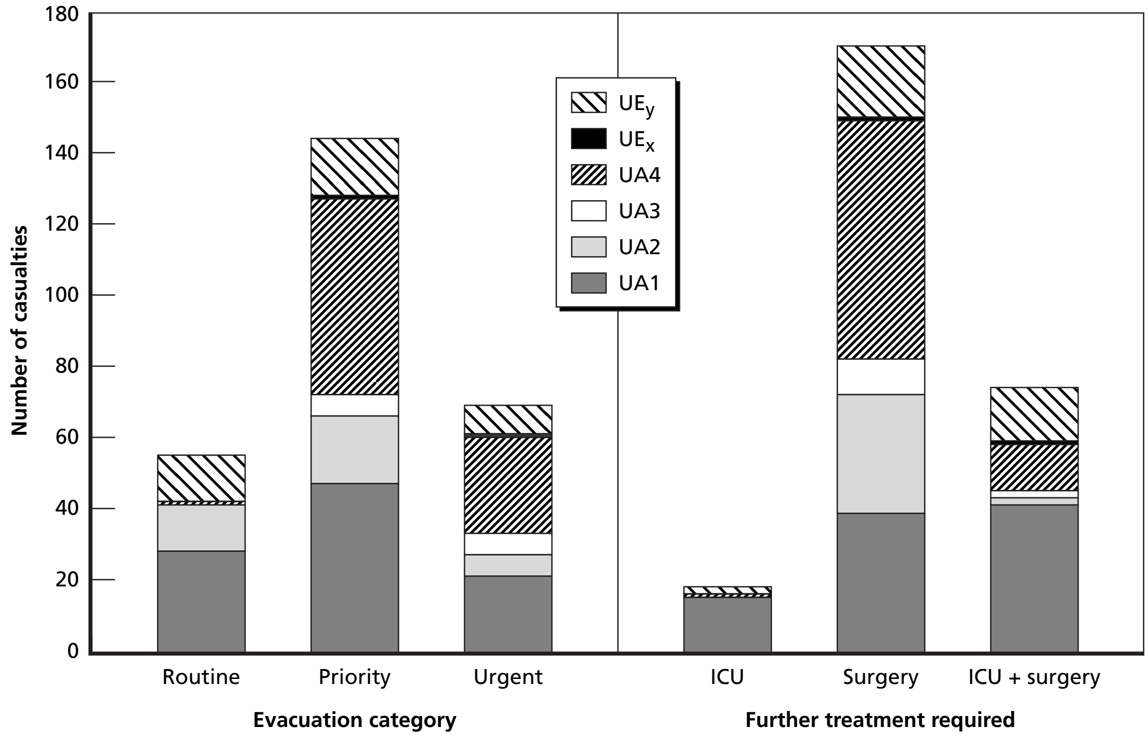
NOTE: L = low, M = moderate, and H = high wound severity.
RAND *TR-302-3.8*

In estimating demand on echelons above the UA, it is also important to estimate when patients require evacuation in the context of this scenario. Figures 3.10 through 3.15 show the number of casualties requiring evacuation and the times they are prepared for evacuation from the UA, by evacuation category and by the need for surgery and/or intensive care. Note that those casualties requiring surgery and/or intensive care (Figures 3.13 through 3.15) are a subset of the total population requiring evacuation and are not in addition to those casualties shown in Figures 3.10 through 3.12. All of these figures are shown against the same time scale to allow comparisons.

As might be expected from the overall casualty flow (see Figure 2.7), the number of casualties requiring evacuation from the UAs peaks early in the battle. This trend suggests the need for robust HSS capabilities at echelons above the UA fairly early (at least in this scenario).

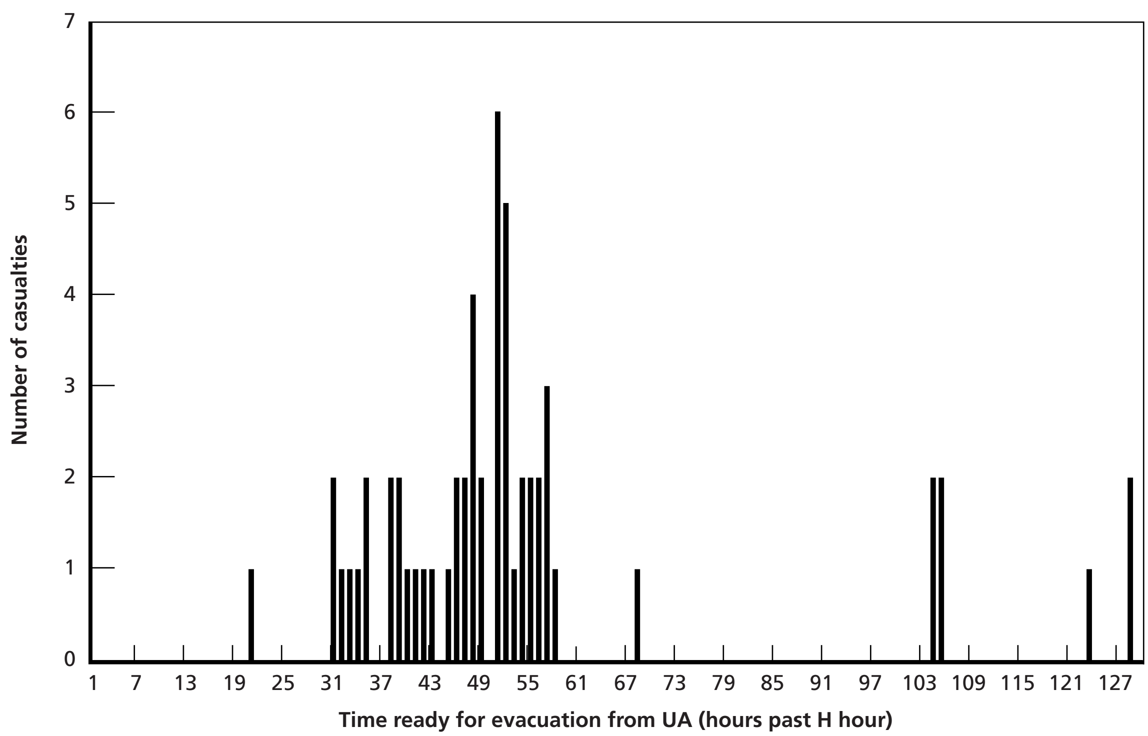
The next chapter in this report will examine the implications of the analysis.

Figure 3.9
Number of Casualties Requiring Evacuation to Echelons Above the UA (268 total)



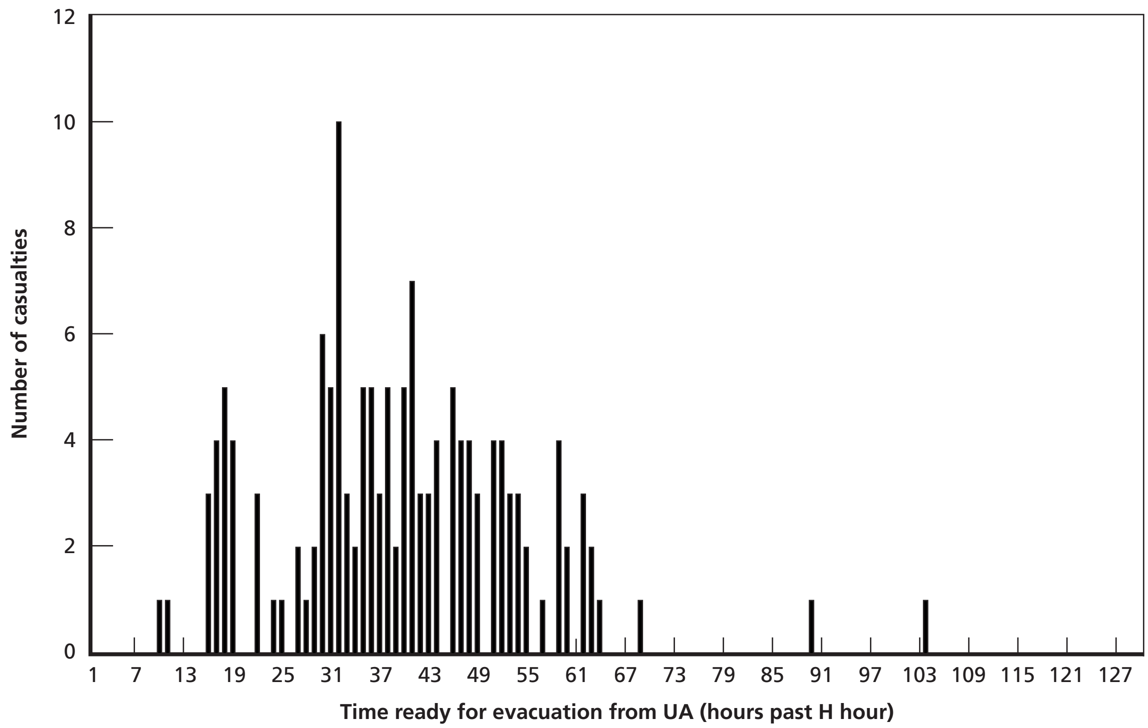
RAND *TR-302-3.9*

Figure 3.10
Distribution of "Routine" Casualties that Require Evacuation from the UA Over Time (57 total)



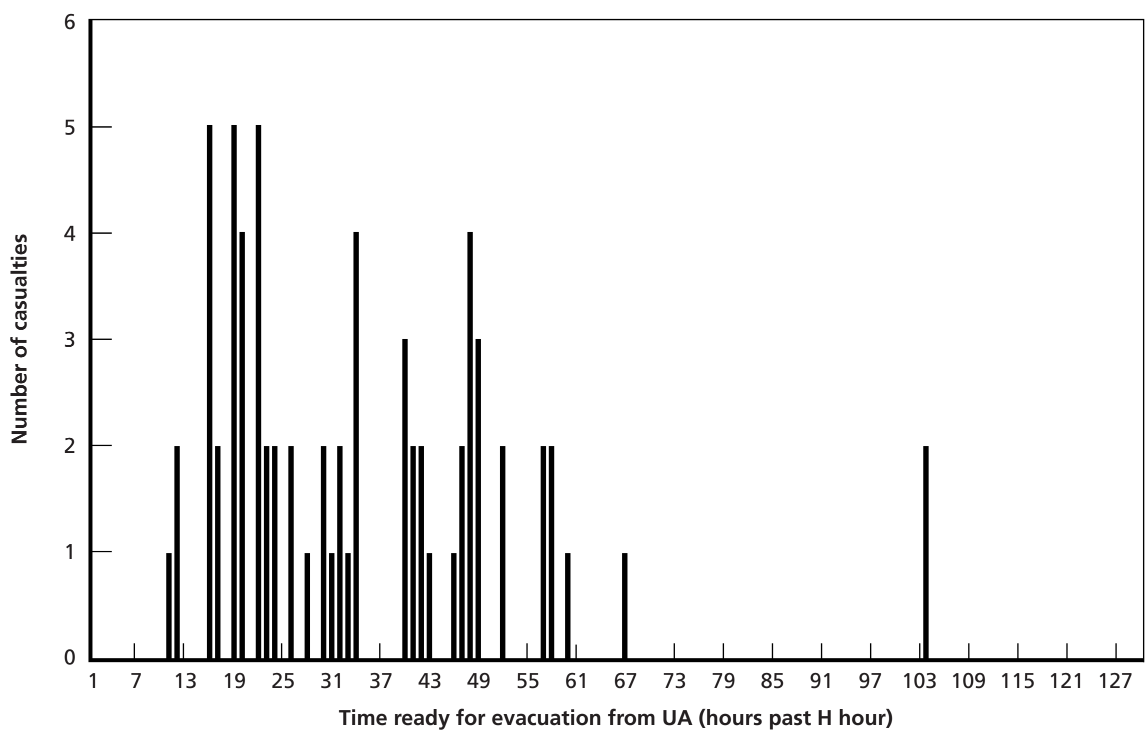
RAND *TR-302-3.10*

Figure 3.11
Distribution of "Priority" Casualties that Require Evacuation from the UA Over Time (142 total)



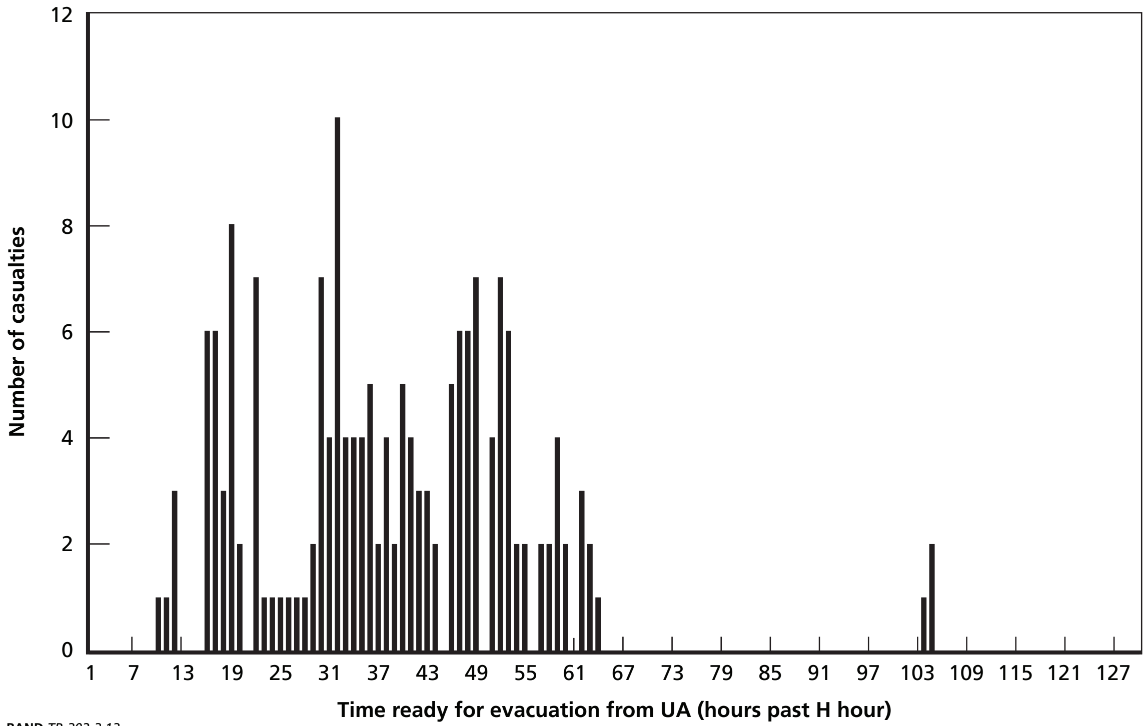
RAND *TR-302-3.11*

Figure 3.12
Distribution of "Urgent" Casualties that Require Evacuation from the UA Over Time (69 total)



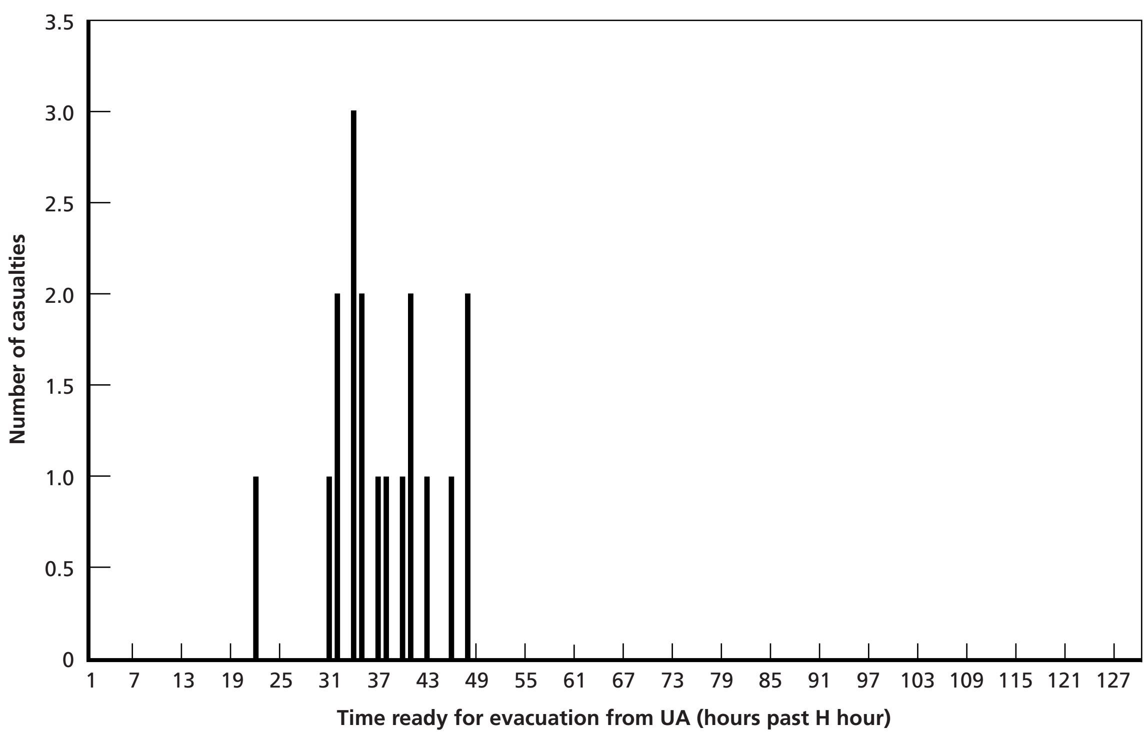
RAND *TR-302-3.12*

Figure 3.13
Distribution of Casualties Requiring Surgery But Not Intensive Care at Echelons Above the UA Over Time (172 total)



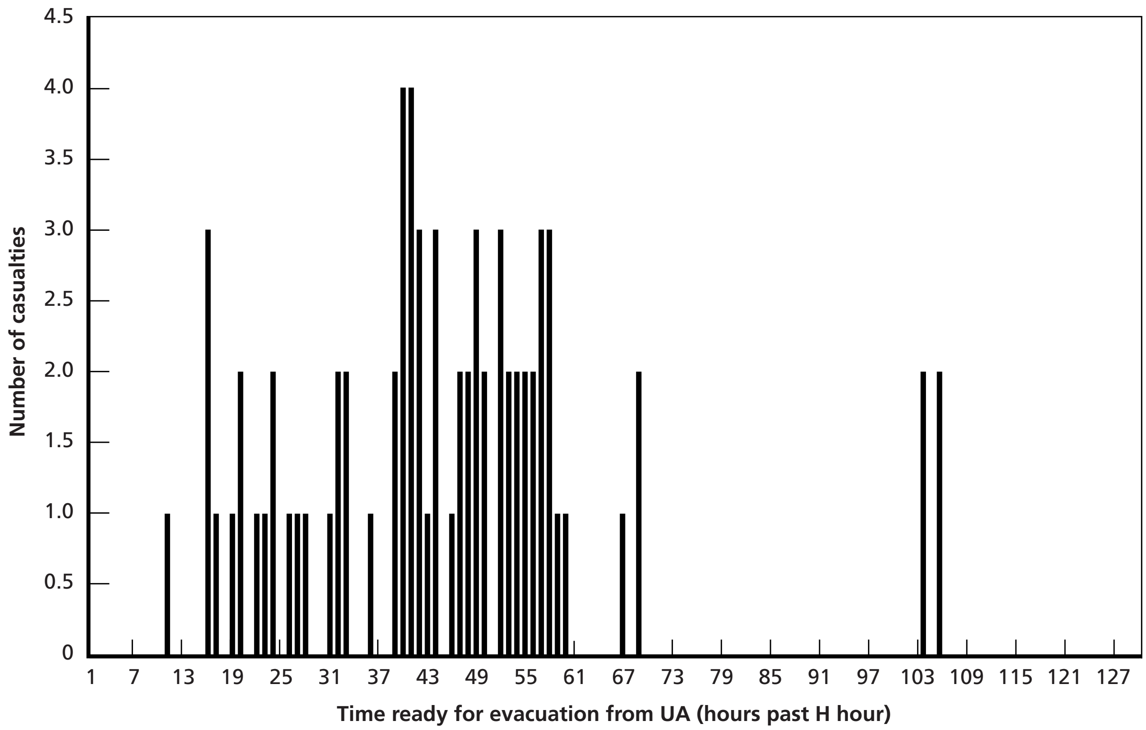
RAND *TR-302-3.13*

Figure 3.14
Distribution of Casualties Requiring Intensive Care But Not Surgery at Echelons Above the UA Over Time (18 total)



RAND *TR-302-3.14*

Figure 3.15
Distribution of Casualties Requiring Both Intensive Care and Surgery at Echelons Above the UA Over Time (74 total)



RAND *TR-302-3.15*

CHAPTER FOUR

Observations and Conclusions

This workshop was designed primarily to analyze the residual demand multiple UAs will place on the echelons-above-the UA HSS system for a specific scenario. Consequently, if a UA could not adequately deal with a casualty, it was assumed that the casualty would be evacuated to an echelons-above-UA HSS system component that could. The HSS system in the UAs was heavily taxed, and the residual demand for evacuation and care at higher echelons was similarly significant.

The remainder of this chapter contains our observations and discussion of our conclusions. Our observations fall into three categories: answers to the ATW V questions, specific medical observations based on the ATWs, and the broader implications for the Army that were deduced from the workshops. It is worth noting that these observations are virtually identical to those expressed after ATWs I–IV, an indication of their validity, given the commonality of the findings of the five workshops.

The complete effect of the casualties examined during ATW V on the HSS system is not known at this juncture, because the workshop could examine only the effect on the UA system—the HSS system at higher echelons has yet to be fully developed. Similarly, it is important to note that the final disposition of those casualties who are awaiting evacuation to echelons above the UA is not completely certain. In the time beyond H+100 hours, the percentage of DOW casualties likely will either remain the same or increase, since some seriously wounded casualties awaiting evacuation could die during the wait. In other words, nearly two-thirds of the casualties were determined to be ready for evacuation to higher echelons, and their disposition will necessarily depend upon capabilities at those echelons.

Answers to ATW V Questions

The three questions posed for ATW V, and their answers, follow.

What Was the Disposition of Casualties (Casualty Outcomes) at the End of the Scenario?

The scenario generated 429 casualties during the approximately 100-hour battle. The causes, types, and timing of these casualties were described in Chapter Two, and their outcomes were described in Chapter Three. The rates of casualties who died of wounds and who were killed in action in ATW V were similar to those in previous workshops, even though they were based on different scenarios (Johnson and Cecchine, 2004). This similarity is likely because of the robustness (or lack thereof) of the UA HSS system and the types of combat operations depicted in the scenarios.

A significant difference from past workshops is the high rate of limb loss estimated in ATW V. While some of this difference may be attributed to better methods of estimation, it is nonetheless worth noting. Limb loss occurred in 58 casualties, representing 13.5 percent of all casualties. Limb loss occurred in 21.6 percent of casualties who were not RTD, DOW, or KIA. In other words, one-fifth of surviving casualties, who were wounded seriously enough to be removed from duty, either suffered an amputation or would likely do so if they survived long enough to be treated at echelons above the UA.

What Was the Status of the HSS System at the End of the Scenario?

As in previous workshops, the HSS systems in the UAs operated at or near capacity for most of the duration of the scenario. Surgical capabilities were the most taxed: UA FSTs performed 118 surgeries totaling approximately 114 surgical hours, not including pre- or postoperative procedures, and surgical demand ranged among UAs from 18 to 46 cases. The FST that performed the most surgeries also experienced the greatest delay times from wounding to surgery.

The campaign plan did not allow for the UAs to provide lateral support to one another. This was largely because of the distances involved and the fact that the UAs were moving rapidly, but also because it would have been unclear to planners where and when the greatest medical demand would occur. Given the limited resources of an FST (i.e., two surgical tables), a reasonable HSS plan would not encumber a UA's FST with casualties from another UA in the face of this uncertainty, making the first FST temporarily unavailable for casualties from its own UA. The fact that an FST is immobile when it is treating casualties further precluded lateral support, since the battle was highly mobile, and an FST that stopped to treat casualties from another UA would fall behind its own UA, exacerbating the problem of long evacuation distances.

The workshop SMEs carefully managed the triage of surgical patients in consideration of the austere surgical capability, often "bumping" patients in favor of others more critically wounded. This practice, enabled by remote triage capability, likely contributed to the elevated risk of limb loss.

Evacuation assets were also used near capacity during the scenario. The dispersion of the battlefield and number and timing of casualties requiring evacuation and care contributed to long delays before a casualty reached surgery (for those requiring surgery); however, the surgical load also contributed to this delay, and it is difficult to determine precisely the contribution of evacuation asset availability. The delay times from wounding to surgery and from wounding to evacuation from the UA were discussed in the previous chapter.

How Many Casualties Required Further Evacuation and Treatment at Echelons Above the UA?

Chapter Three details the types of casualties requiring further evacuation and treatment as well as the flows of casualties that were ready to be evacuated to echelons above the UA. Similar to ATW IV, approximately two-thirds of casualties required evacuation to higher echelons. Of these, nearly 80 percent were classified as "urgent" or "priority," and approximately two-thirds would require surgery at echelons above the UA. Partially because of an early peak in the casualty flow in the scenario, the number of casualties requiring evacuation from the UAs similarly peaked early in the battle. This trend suggests the need, in this scenario, for robust HSS capabilities at echelons above the UA fairly early.

Workshop Implications

The workshop implications will be discussed in two categories: workshop implications for the HSS system and workshop implications for the Army. These findings are very similar to those from ATW IV.

Workshop Implications for the HSS System

Combat Lifesaver Competencies. A significant aspect of emerging Future Force operational concepts is the dispersed nature of UA forces. Given the envisioned capabilities of Future Force weapon systems, coupled with the quality of situational awareness, units will be able to control much larger areas of terrain. Additionally, individual systems will be much more dispersed on the battlefield than presently configured—routinely by as much as three to four kilometers. Thus, when a manned vehicle was hit by enemy fire that produced casualties in the workshop scenario, that vehicle was largely isolated from the other vehicles in the unit. Furthermore, these vehicles and their casualties were (in the simulation) left behind as the remainder of the unit continued to move rapidly toward its objectives.

The dispersion of vehicles in this scenario placed a premium on the skills of CLSs and their ability to employ the advanced medical technologies (see Appendix C) used in the workshops to care for casualties until they could be evacuated. These skills and abilities were particularly important because combat medics were frequently unable to get to casualties in a timely manner, either because of the distance to the casualty or because they were already treating another casualty.

In the view of the SMEs, the CLS skills assumed by the workshops greatly exceed what is expected of a CLS today and in reality approach what is expected of a 91W combat medic. For example, in the workshops, CLSs were assumed to apply dressings and tourniquets, clear airways, manage fractures, and administer many of the 21 advanced technologies incorporated in the workshops. From the perspective of casualty outcomes during ATW I–IV, these extraordinarily competent CLSs were critical to the effectiveness of the HSS system. The same remained true in ATW V.

The role and importance of the CLSs raise several issues that need further analysis. First, there was broad consensus that the initial and ongoing sustainment training of CLSs needs to be thoroughly assessed to determine feasibility, considering the proficiency levels demanded by the workshops. In short, is it possible to train a future soldier to be both an infantryman and a highly competent CLS and to maintain both skill sets over time? Second, performing as a CLS will be a secondary role for UA combat arms soldiers, just as it is now. Consequently, CLSs will face an inherent tension during combat between providing combat casualty care and fighting. In these workshops, the CLSs were assumed to provide care and thus made a significant contribution to favorable casualty outcomes. However, the workshops did not assess the impact of these CLSs being taken away from their combat duties.

The Role of the Platoon Combat Medic. The workshop SMEs concluded that the highly dispersed, fast-moving operations called into question the role of the platoon combat medic. The principal issue was the proximity of the platoon medic to casualties. Even though the location and type of injury for each casualty was provided during the workshop, if the casualty was not in the same vehicle as the medic, the distance to the casualty was generally at least a kilometer. Consequently, it was not feasible for the medic to move by foot to the casualty. This created a dilemma that was recognized by workshop participants. To move the medic to the casualty, the FCS vehicle carrying the medic would have to be diverted from the mission. Such a decision would degrade platoon combat capability. In the workshop, this dilemma was largely resolved, as noted above, by investing the unit CLS with extraordinary competence and capabilities, principally in the form of advanced medical technologies. The best assistance the medic could potentially provide in these cases was remote advice to the CLS.

Again, as described in the reports on ATWs I–IV, the SMEs noted this aspect does not imply that Future Force medics will not play a significant role in other dimensions of force health protection. As they are today, medics will be involved in training CLS and other soldiers, performing on-site and remote triage during battle, dealing with disease and non-battle injuries, and myriad other readiness-related duties that have traditionally required combat medics. What this workshop (and ATWs I–IV) did point out, however, was the immense difficulty that combat medics will have in providing immediate response to casualties in highly dispersed, fast-moving combat operations.

Medical Technology. During this workshop, as in ATWs I–IV, the utility of advanced medical technologies was not specifically addressed as an analytical issue. Instead, the MRMC provided a list of 21 technologies (see Appendix C) for the workshops that it affirmed would be fully fielded and will perform to stated expectations by 2015. Workshop participants employed the technologies as specified by MRMC. Nevertheless, although the performance of medical technologies was not a stated issue, participants did note several technologies that they believed were critical to combat casualty care during the workshops.

Two critical factors, as frequently noted in this report, made the combat casualty care effort particularly challenging: battlefield dispersion and the distance to (limited) surgical capability at the FST or echelons above the UA. Perhaps the most important technology in the workshops for dealing with the dispersion factor was the Warfighter Physiological Status Monitor. The WPSM provided immediate location and injury-type data for all casualties. This information was invaluable in the medical regulation effort, particularly in allocating evacuation assets. The distance factor for urgent casualties was primarily alleviated by the application of a number of advanced hemostatic agents, which prevented fatal hemorrhage while severely wounded casualties were en route to treatment at the FST. It is very important to note that absent these two critical technologies, casualty outcomes would have been worse.

Aerial Medical Evacuation. On the highly dispersed battlefield portrayed in the workshops, aerial medical evacuation made the difference between life and death for many casualties. Furthermore, its criticality became more pronounced as the battle progressed, because the distance from point of wounding to the FST steadily increased. The probable long distance from UA FST locations to the echelons-above-UA HSS system locations will only increase the criticality of aerial medical evacuation on the battlefields of the future.

Surgical Capacity. The main limiting factor in dealing with the casualties in the workshops was surgical capacity. In this workshop, surgery could be performed in the UA or casualties could be stabilized and transported to higher echelons for surgery. This assumption differed from ATWs I–III, which required that all surgical cases be treated at an FST within the UA, or at a 44-bed CSH that represented the only medical capability available at echelons-above-UA in those scenarios. Following these ATWs, the AMEDD concluded that the 44-bed CSH was insufficient for HSS at echelons above the UA and determined that an effective approach to shaping the requirements for the echelons-above-UA HSS system would rely on a determination of the excess medical demand from the UAs. Therefore, the assumption about where surgeries could be performed was changed for subsequent ATWs because they were designed to determine the demand on echelons of the HSS system above the UA and not to determine the performance of that system. However, in ATW V, casualties also backed up at the FST, and the SMEs carefully managed the surgical queue, judging that some casualties would not survive further evacuation without stabilizing surgery. The results of ATWs IV and V indicate that the UAs' residual load of casualties requiring surgery will create a heavy demand for an echelons-above-UA HSS system surgical capacity.

Additionally, one can assume that the demand for surgery and post-surgical care will increase in the future, particularly given recent experiences in Iraq. Emerging casualty data from Iraq are demonstrating the impact that improved soldier protection and advanced medical technologies are having on casualty outcomes. Better body armor and medical technologies have combined to enable soldiers who would have been KIA in earlier conflicts to survive to reach an operating table, where their lives are frequently saved. In Iraq, the number of casualties over time has not created an excessive demand on the HSS system, and KIA and DOW rates appear to be dropping significantly. Nevertheless, this reduction in KIA and DOW rates could create an unprecedented demand on surgical capacity and post-surgical care in the types of operations depicted in the scenario used in ATW V—a demand that the envisioned UA HSS system has had difficulty addressing in ATWs I–IV.

Finally, in ATW V, as in ATWs I–IV, the FST was not able to displace forward as the battle progressed. Thus, the distance from wounding to operating table gradually increased for casualties as the battle moved progressively farther from the FST location. Again, one could expect even greater distances between the UA FSTs and an echelons-above-UA HSS system.

Workshop Implications for the Army

Several issues arose during ATW V, which were also noted during ATWs I–IV, that are beyond the scope of the AMEDD to address independently. They truly are Army issues.

Lines of Communication and Rear Area Security. As the battle portrayed in this scenario progressed, the lines of communication steadily increased and were left largely unsecured as maneuver units pressed on to their objectives. From the perspective of the HSS system, this situation required ground medical evacuation vehicles to move independently to casualty locations, casualty collection points, aerial medical evacuation landing zones, etc., across a battlefield that was neither cleared nor secured. This situation is not dissimilar to the challenges faced by coalition forces during Operation Iraqi Freedom in securing lines of communication behind combat forces rapidly moving toward Baghdad. Additionally, as already noted, the FST had to stay in a fixed location for the duration of the 100-hour battle to perform its mission. One would assume that it, and the UA medical company, would require some level of defense during this time.

As noted earlier, the workshops assumed there was no attrition of any of the components of the HSS system, in order to portray its capabilities in a "best case" condition. Therefore, the impact of operating in an insecure rear area was not specifically assessed. Nevertheless, it is reasonable to assume that elements of the HSS system would be attacked, particularly if they moved around the battlefield as single entities. Loss of medical personnel or platforms could only worsen medical outcomes.

The issue for the Army is: How will ground and air lines of communication and rear areas be secured in the wake of rapidly advancing Future Force combat units?

Conclusion

ATW V provided valuable insights into the ability of AMEDD's envisioned Future Force HSS system to support a Future Force operation. This workshop also continued the process, begun in ATW IV, of determining the demand that an echelons-above-UA HSS system will be required to meet in Future Force operations. Although the results and insights gleaned from ATW V are unique to a specific scenario and simulation, they do point to the potential medical challenges posed in supporting rapid Future Force operations on a highly dispersed battlefield.

The workshop also reinforced the importance of simulating Future Force concepts and the criticality of in-depth, subject matter expert analysis in assessing the outputs of any simulation. In the case of this workshop, every casualty generated by the simulation was tracked from the point of wounding through the UA HSS system by experts in all the components of combat casualty care. Thus, the teams were able to articulate credible casualty outcomes and the challenges facing emerging AMEDD concepts, structures, and technologies in supporting postulated Future Force operations. The team members stressed that further simulations of additional scenarios of evolving Future Force concepts should continue to ensure that the AMEDD can articulate to the Army the medical risks involved in those concepts and the ability of the future HSS system to mitigate those risks to a level acceptable to the Army. Such analysis will support the design and implementation of an HSS system capable of conserving the fighting strength of the Army's Future Force. It is hoped that this report and future ATWs, using appropriate and suitable supporting scenarios, will be valuable in the development of HSS structures and operational concepts at levels above the Unit of Action.

APPENDIX A

ATW V Participants

Table A.1
Participants

Subject Matter Expert	Team 1	Team 2
Team Leader/Surgery	COL Thomas Knuth	MAJ Richard Pope
Surgery		Dr. Huang
Nursing	LTC Kathleen Ryan	COL Anita Schmidt
Physician's Assistant	CPT Dawn Orta	1LT Michael Smith
Combat Medic (91W)	MSG Steven Kerrick	SSG Scott Adkins
Evacuation	MAJ Fristoe	LTC Tim Moore
Medical Technology	Mr. David Smart	
Unit of Action	Mr. Dave Hardin	Mr. Jim Brazaele
Medical Company	CPT James Morrison	CPT Jon Baker
RAND Facilitator	Ms. Terri Tanielian	Dr. Richard Darilek
RAND Data Collectors	Mr. John Bondanella	Dr. Martin Libicki
	Dr. Jennifer Moroney	Dr. Anny Wong

Table A.2
Control Cell

Control Cell Member	Position
COL L. Harrison Hassell	Workshop Control, AMEDD C&S
COL Johnny L. West	Workshop Control, AMEDD C&S[a]
Dr. David E. Johnson	Project Leader, RAND
Dr. Gary Cecchine	Project Leader, RAND
Mr. Pat McMurry	Analyst, AMEDD C&S
Mr. Fred Watke	Analyst, AMEDD C&S
Mr. Mike Ingram	TRAC-Fort Leavenworth, Kan.

[a] COL West also participated as evacuation SME on one of the teams during his participation in the workshop.

APPENDIX B

ATW V Scenario

The information in this appendix was provided to workshop participants to support and facilitate the Center for AMEDD Strategic Studies Army Transformation Workshop V, 25–28 May 2004. The appendix is organized into five sections. The first section provides a brief description of the scenario on which the casualty distribution is based; the second section discusses key elements of the Unit of Employment; the third section provides key elements of the UE operational plan executed in simulation; the fourth section presents the UE casualty distribution to be considered in the workshop; and the final section shows some additional medical support considerations suggested by the scenario.

Scenario Characteristics

This section provides a brief description of the scenario on which the workshop is based. The scenario problem is described first, then the operational environment, and finally the joint forces that are present in the overall scenario.

Problem

The scenario is based on a TRADOC Standard Operational Scenario used to support combat development. The scenario was provided by the TRADOC Analysis Center—Ft. Leavenworth. It describes an SSC situation requiring a strategic response to a distant, immature theater. In this case, Blue intervenes in a country to restore a friendly government overthrown by a rebellious majority of its military. The intervention escalates to MCOs.

Blue faced a variety of operational-level missions and tasks. The most important among them was to help reinstate the friendly government requesting assistance. This mission focused the Blue force on isolation of the strategic center of gravity (i.e., the capital region). Blue also had to defeat anti-government enemy forces in the country. Blue was further tasked to deter any third country intervention on the side of the rebellious forces. Blue forces also had to cut the lines of communication (LOC) from the capital region toward the south to this regional power. Finally, they had to ensure the ability to conduct follow-on operations.

In this scenario, Army Future Forces conducted operations as part of the main effort of the Blue force counteroffensive—decisive operations conducted after a month-plus force buildup in theater. Army ground forces conducted operational maneuver, executing distributed and continuous operations in both open and rolling, and urban and other complex terrain.

Simulated Operations

In tactical-level simulation, the simulated part of the scenario depicted an FCS-equipped maneuver UA conducting an attack against a brigade-equivalent threat force. The engagement occurs in an area as large as approximately 75 by 85 kilometers.

In an operational-level simulation (to be considered during ATW V), the simulated part of the scenario began just prior to when UE_y (corps-level task force), an element of the coalition task force, began attacking and making contact with the enemy, and ended with the isolation of the country's capital (just over four days). The initial UE_y movement into theater and the culminating attack on the capital city were not simulated. An extended UE_y physical battlespace of over 500 kilometers by 225 kilometers was represented in simulation.

Operational Environment

Physical Conditions. Several salient features characterize the physical terrain in the scenario: foothills and rugged mountainous terrain, urban and other complex terrain, a large reservoir, rivers, and an irrigation complex in a large, extensive valley flood plain consisting of canals and ditches. The mountainous portion of the UE_y area of operations is less populated and less occupied by defending forces (other than reconnaissance assets). Portions of the AO are urbanized with a somewhat sprawling network of villages, towns, and cities situated among the maneuverable, but restricted, mobility corridors in the region. There are pockets of highly compartmented terrain throughout the zone.

Threat Forces. Enemy forces in the AO included three corps, organized around 12 maneuver brigades.[1] There were over 40,000 troops, 2,000 armored fighting vehicles, 450 mobile air defense systems, and 600 artillery systems in the simulation of this AO. (Total enemy forces exceeded 100,000, with maneuver brigades of 3,000 personnel each.) Red also employed about 3,800 man-portable air defense systems (MANPADS) across its forces. (The tactical problem in ATW IV involved elements of three brigades and supporting forces.)

Threat Concept. Focused on preservation of political and military power, the enemy planned to defend primarily from urban and other complex terrain throughout the AO. Most of Red's conventional forces remained concealed in well-prepared defensive positions in the urban areas in an attempt to preserve combat power and to draw Blue forces into these spaces for an urban fight. Red forces expected the urban fight to negate the technological advantage of Blue forces, increase Blue casualties, and slow Blue's momentum, all aimed at degrading Blue's will to fight and carry on the operation. The enemy was positioned in recognition of potential Blue intervention and Future Force capabilities in this scenario. Specifically, the enemy's strategic defense recognized the possibility of the Future Force approaching from multiple directions, and thus more enemy forces were positioned at the east end of the large reservoir for flexibility against either of two avenues of approach that Blue might choose.

All Red forces tied their defenses into both natural and man-made obstacles, primarily the rivers, lakes, and compartmented terrain spaces. The Red defense coordinated these obstacles with their surveillance-strike complex, fires complexes, and an Integrated Air Defense System to ensure that Blue forces entering the obstacles and defensive perimeters were identified and targeted with both indirect and direct fires. Red forces focused their surveillance on the more open maneuver corridors into the country in an attempt to target Blue

[1] Some additional forces remained neutral and were physically separate from rebellious forces.

forces as Blue attacked across this region. Red planning included the exploitation of displaced persons and other civilians in the battlespace to complicate Blue maneuver, fires, and logistics. The battlespace was further complicated by the proliferation of MANPADS.

The following is a summary of the major attributes of the scenario:

- Major Combat Operations are conducted in a distant, immature theater.
- There are theater restrictions that limit maneuver options.
- The physical battlespace is extensive.
- The tactical maneuver space is highly restricted.
- There are compartmented, complex terrain approaches.
- There are neutral forces in the AO.
- There is the possibility of numerous displaced persons.
- Blue seeks to
  - facilitate reinstatement of friendly government
  - isolate strategic center of gravity
  - defeat enemy forces
  - deter intervention
  - cut strategic LOC
  - facilitate follow-on operations.
- The operational environment includes
  - an urban/other complex terrain-based strategic defense
  - extensive paramilitary forces
  - supporting fixed wing and helicopters
  - integrated air defense system (> 450 mobile AD systems)
  - supporting cannons and multiple rocket launchers), (> 600 artillery systems)
  - short- and intermediate-range ballistic missile systems
  - significant MANPADS threats (~ 4,000 systems).
- The threat seeks to
  - preserve power
  - preserve military capability
  - preserve control over natural resources.

Joint Forces

CFACC. The Combined Force Air Component Command in this scenario included two air expeditionary forces (AEFs). These AEFs included strategic “enabler” or common user assets, such as long-range mobility and space forces. The CFACC included an abundance of various combat aircraft and munitions to fulfill strategic attack, joint suppression of enemy air defense, air superiority, and counter-land roles. Additionally, key Air Force intelligence, surveillance, and reconnaissance assets (U2, E-8 Joint STARS, E-3 AWACS, and RC-135 Rivet Joint) played a critical role in setting conditions for the operation.

JFMCC. The Joint Force Maritime Component Command included one carrier vessel battle group (CVBG) tailored to the scenario. The CVBG provided multiple combat capabilities with its fighter aircraft, surface vessels, air and missile defense assets, and submarines. This carrier provided an air basing capability that augmented land-based air assets around the periphery of the theater and the threat country and provided additional air assets to the CFACC.

CSOTF. The Combined Special Operations Task Force included the joint psychological operations task force and the joint civil-military operations task force. Overall, the CSOTF focused on special reconnaissance, direct action, civil affairs, and psychological operations activities. In all of these, special operations forces reinforced, augmented, and complemented conventional forces in theater. They also conducted independent operations, including a hostage rescue that initiated Blue operations.

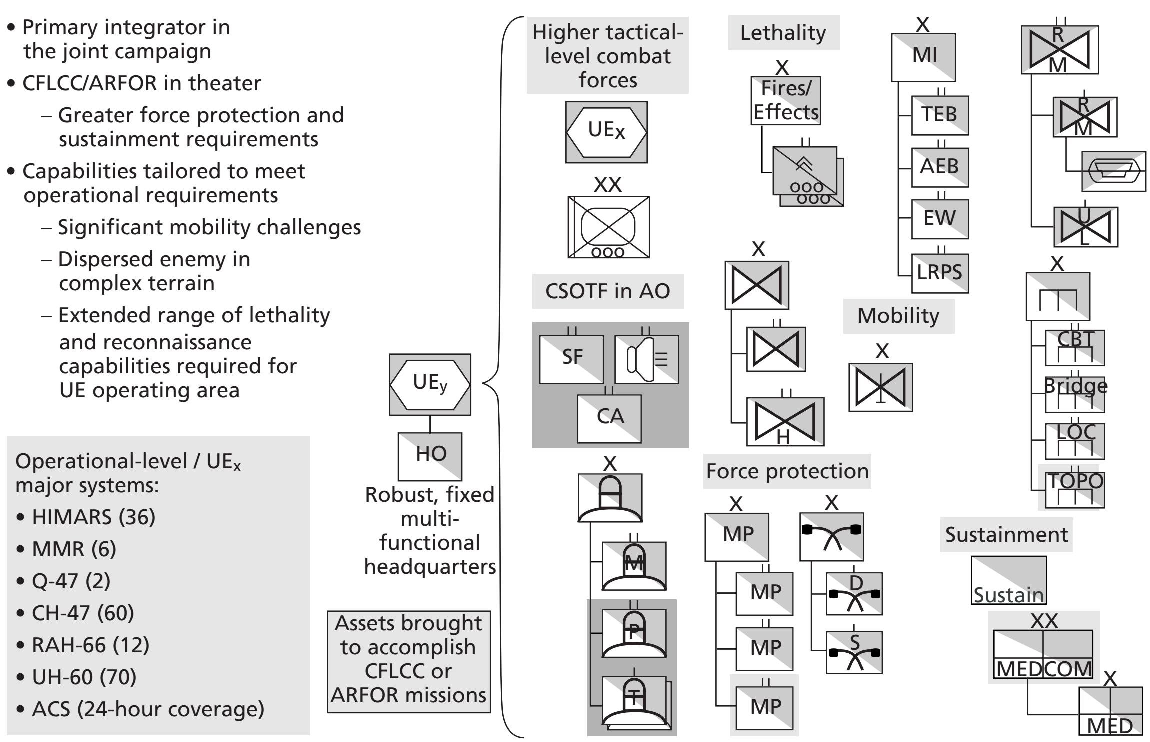
CFLCC. The Combined Forces Land Component Command included one Army UE_y, one Marine expeditionary brigade, and one coalition mechanized brigade. The simulation focused on the operations of the Army UE_y, the main effort of the theater decisive operations, and represented all significant actions of the forces of the UE_y from their respective assembly areas to their locations at the time isolation of the capital was achieved.

Unit of Employment

An Army UE_y headquarters served as the CFLCC. Army forces under this UE_y headquarters included one UE_x, a Stryker Division (notional), and UE_y support. The forces, as task-organized under this UE_y headquarters for this operation, are shown in Figure B.1.

Two Army echelons above the UA were developed for the scenario for the FCS analysis of alternatives. These are *pre-decisional* UEs designed to provide enabling capabilities

Figure B.1
UE_y Forces



RAND *TR-302-B.1*

for the UAs employed in the scenario. The tailored UEs reflected the operational environment, threat, physical aspects of the battlespace, and operational missions in the scenario.

The UE_y represents the highest Army echelon in this case. The Caspian UE_y serves as the CFLCC and Army Forces Headquarters (ARFOR) in the theater, expanding the requirement for air defense assets, certain engineer assets, military police, and medical capabilities that it must bring into theater.

The Caspian UE_y was task organized with one UE_x and one Stryker Division. There are approximately 14,000 personnel in the UE_x and 16,700 in the Stryker Division. The Stryker Division is a notional organization that was explored in concept development and analysis in TRADOC just prior to the initiation of the FCS analysis of alternatives. There are currently no plans to field a Stryker Division; it simply represents a possible divisional context for the employment of Stryker Brigade Combat Teams.

The Caspian UE_y fires/effects brigade included two High Mobility Artillery Rocket System (HIMARS) battalions, each with three batteries of six HIMARS per battery and a headquarters element. No cannons were included in the fires/effects brigade as these capabilities were embedded in the UAs. Multi-Mission Radar (MMR) was included at UE_y level.

The Military Intelligence (MI) Brigade included tactical and aerial exploitation battalions, an electronic warfare battalion, and a long-range reconnaissance and surveillance company. The Aerial Common Sensor was a significant asset provided by the MI brigade.

Two aviation brigades provided lift capabilities for air assault operations and for extensive aerial resupply operations.

Additionally, a regimental aviation squadron provided reconnaissance capabilities with RAH-66 (Comanche) helicopters and tactical unmanned aerial vehicles.

The UE_y also included a significant air and missile defense capability. In addition to a Medium Extended-Range Air Defense System battalion, the force included a Patriot battalion and two Theater High Altitude Air Defense batteries in support of the UE_y's role as the CFLCC.

The engineer brigade included a battalion each of combat, bridge, and LOC engineers, reflecting the different types of bridging and breaching requirements the UE_y would encounter. The terrain included complex obstacles, rivers, and compartmented terrain, and the UA did not have the organic assets to rapidly traverse this battlespace without augmentation. A topographic engineer company was included for CFLCC requirements.

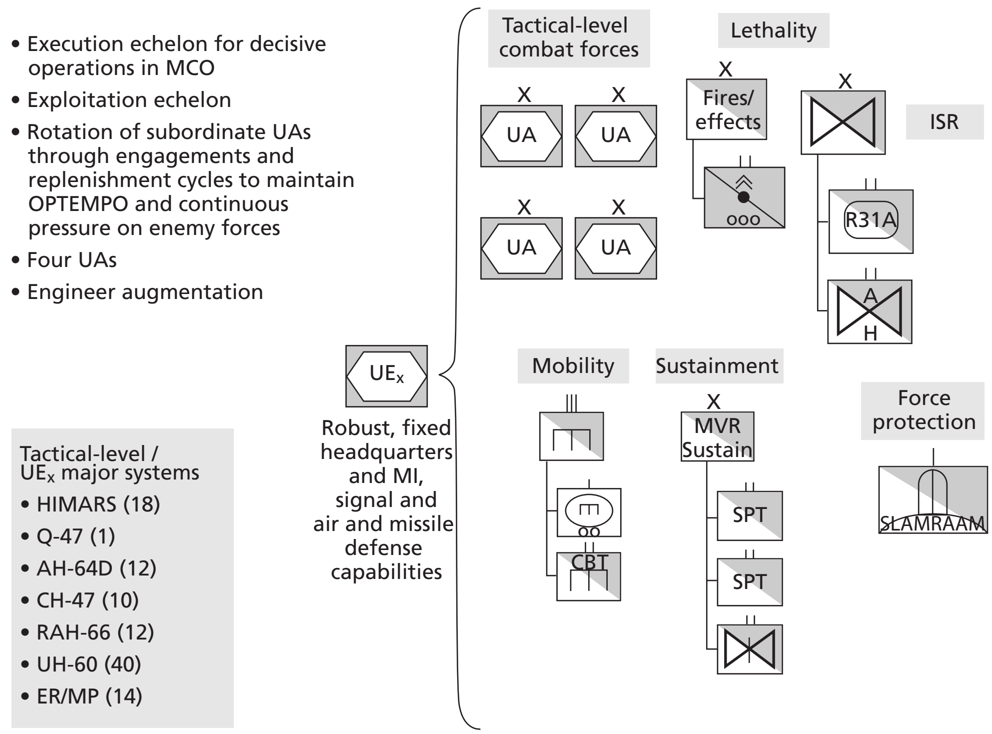
The military police brigade included three battalions, recognizing the expanded role of the UE_y in LOC security across the theater and in handling refugees and enemy prisoners of war. The chemical brigade included decontamination and smoke capabilities.

The Maneuver Sustainment force included a divisional-sized medical command and a medical brigade. This was related to UE_y ARFOR responsibilities. Finally, the Caspian CSOTF pool included special forces, civil affairs, and psychological operations battalions.

The UE_x forces assembled to execute this operation are shown in Figure B.2.

The UE_x in simulation represented the UE at the higher tactical level. The UE_x was based on a TRADOC UE1 (now UE_x) developmental framework included in the 22 July 2002 *UA Organization and Operations Plan* documentation (used by TRAC in its development of the scenario). The UE_x is the execution echelon for decisive operations in major combat operations and acts as the exploitation echelon. A UE_x executes operations by employing UAs in cycles of engagements and battles, maintaining high operational tempo (OPTEMPO) and continuous pressure on selected enemy forces across respective AOs.

Figure B.2
UE_x Forces



RAND *TR-302-B.2*

The UE_x in the Caspian scenario included a fixed headquarters element with robust signal and intelligence capability and Surface-Launched Advanced Medium Range Air-to-Air Missile augmentation; four FCS-equipped UAs; an aviation brigade providing air and ground reconnaissance and surveillance capability, and attack aviation; a HIMARS battalion; an engineer capability and augmentation; and sustainment capability. There are approximately 14,000 personnel in this UE_x.

The UE_x's artillery organization included a Q-47 counter-battery radar section. However, the UE_x was not provided cannon augmentation because of the cannons organic to the UA.

The aviation brigade included both RAH-66 and AH-64D aircraft. It also included the Army Airborne Command and Control System for the UE_x and lift helicopters for air assault and sustainment support.

Unit of Employment Operational Plan

The mission and intent that framed this operation are shown below:

- **UE_y Mission Statement.** On order, UE_y attacks to defeat threat forces, in order to facilitate the reinstatement of the legitimate government.

- **Commander's Intent.** The intent is to capitalize on the increased maneuverability of the FCS to rapidly isolate the capital, decisively engaging those threat forces necessary to facilitate access to this objective, yet violently and decisively rendering combat ineffective those threat forces that are not engaged. Decisive to this operation is the isolation of the capital. The end state for this operation is that threat forces are defeated, Objective (OBJ) Golf is secure, LOC between the capital and the sympathetic nation to the south are severed, and UE_x is prepared to pass the Stryker Division forward or to continue offensive operations.

An overview of the operation is shown in Figure B.3.

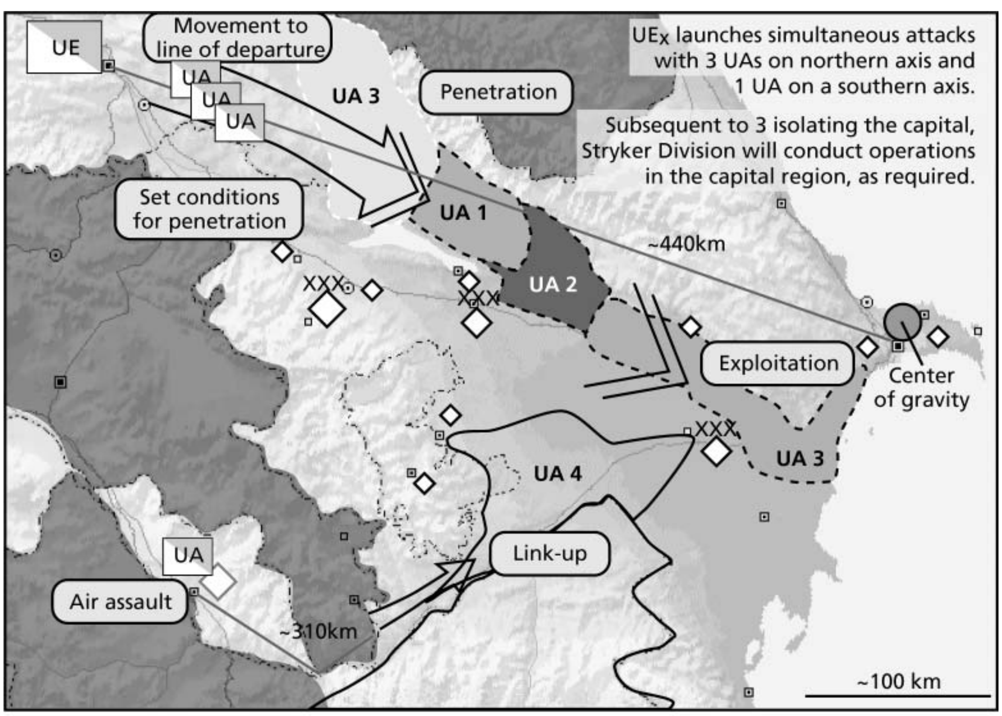
Key elements of the UE_y operations plan are shown in Table B.1. These are shown by maneuver UAs and other major functional elements of the force, and by phase of the operation.

UA Operational Plans

The four maneuver UAs planned to conduct operations as described and shown below. The charts show 50-kilometer grid lines; small circles reflect built-up areas. Forward support battalions containing FSTs and medical companies move over time to support operations.

UA 3. In the north, UA 3 is first in order of movement from Tactical Assembly Area Major toward the border and will set conditions for the ground attack by UA 1 and UA 2. UA 3 must seize and secure three crossing sites over the river on the border. If it fails to seize bridges that are intact, it will secure bridging operations at these sites until completed and

Figure B.3
Operation Overview



RAND *TR-302-B.3*

Table B.1
Key Elements, by Phase, of the UE_y Operations Plan

	Phase I (Movement to Line of Departure)	Phase II (Penetration)	Phase III (Exploitation)	Phase IV (Isolation)
UA 1	Conduct tactical movement to crossings	Destroy enemy forces in vicinity of OBJ Alpha to enable forward passage of UA 2. Block enemy forces in the vicinity of OBJ Bravo	Block enemy forces in the vicinity of OBJ Bravo to facilitate UA 2 attack	
UA 2	Conduct tactical movement to crossings	Pass through UA 1 and defeat enemy forces in the vicinity of OBJ Delta. Block enemy forces in the vicinity of OBJ Bravo. Allow UA 3 to attack on Axis Six (eastern end of reservoir through northern part of valley)	Block enemy forces in the vicinity of OBJ Bravo to facilitate UA 2 attack. Secure OBJ Delta	
UA 3	Conduct tactical movement to crossings. Secure river crossing sites in the vicinity of the line of departure (LD)		Pass through UA 1 and UA 2 and destroy enemy in the vicinity of OBJ Golf to enable unimpeded passage of Stryker Division IV to Baku	Seize OBJ Golf and isolate the capital
UA 4	Conduct tactical movement—intra-theater lift to Tactical Assembly Area (TAA) Minor	Two companies of UA 4 conduct an air assault into OBJs Hotel and India. Set conditions for linkup	Attack to seize airfields in the vicinity of OBJ Juliet and sever the LOC between the capital region and country to the south	
UE_x RSTA[a]	Conduct reconnaissance along Axis One (TAA Major toward OBJ Alpha) to confirm enemy locations and crossing sites	Conduct reconnaissance on OBJ Alpha to confirm enemy locations and passage routes	Transition to screen to refit, post–UA 2 attack on OBJ Golf. Provide early warning and targeting of enemy anti-tank regiment	Maintain screen to south
UE_y Regimental Aviation Squadron	(+LRRS[b]) Screen along Phase Line (PL) Red (along border to west end of reservoir) to provide early warning and targeting	(+LRRS) Continue to screen along PL Red to provide early warning and targeting		
UE_y Aviation	Support establishment and maintenance of corps screen	Support maintenance of corps screen	Support maintenance of corps screen	
UE_x Aviation	Shape attack on enemy forces in the vicinity of OBJ Bravo	Shape attack on enemy forces in the vicinity of OBJ Bravo. Spoil attack on OBJ Echo	Execute spoiling attack on OBJ Echo to facilitate UE_y exploitation (with UA 3)	
UE_y Fires	Conduct shaping attacks into OBJ Bravo	Conduct shaping attacks into OBJ Bravo	Deliver interdiction fires	
UE_x Fires	Conduct shaping attacks (ATACMS[c]) into Bravo	Conduct shaping attacks into OBJs Alpha and Bravo. Shape and support fires into Delta	Conduct interdiction fires. Joint effects are used to fix enemy forces in the vicinity of OBJs Echo and Foxtrot	
UE_x aviation	Shape attack on enemy forces in the vicinity of OBJ Bravo	Shape attack on enemy forces in the vicinity of OBJ Bravo. Spoil attack on OBJ Echo	Execute spoiling attack on OBJ Echo to facilitate UE_y exploitation (with UA 3)	

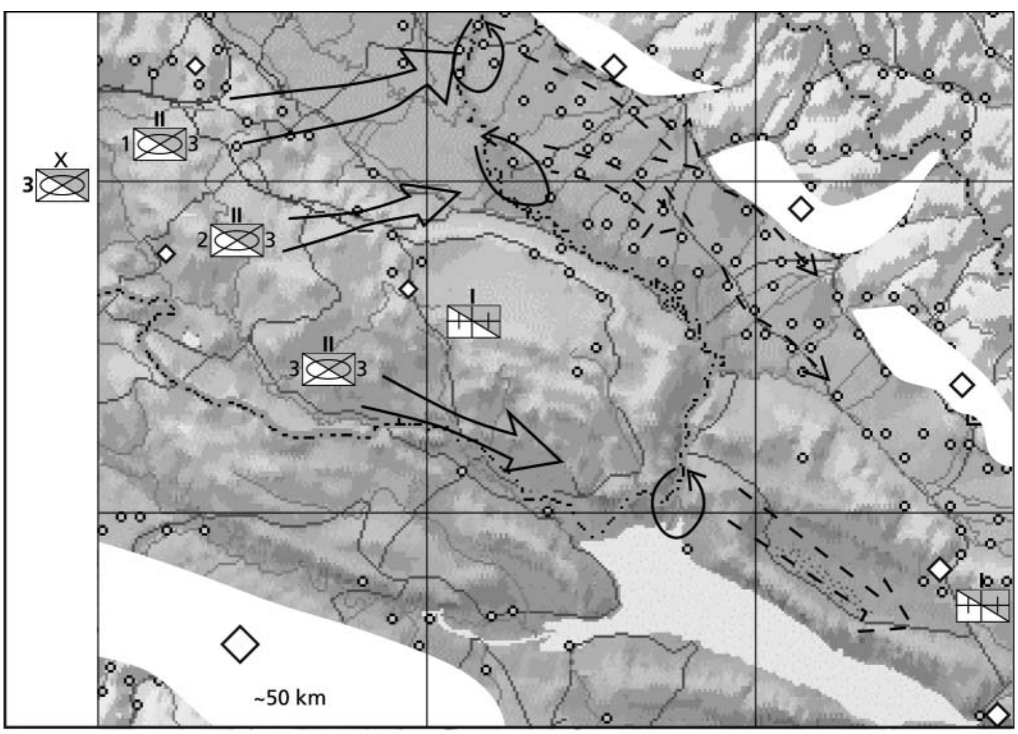
Table B.1—continued

	Phase I (Movement to Line of Departure)	Phase II (Penetration)	Phase III (Exploitation)	Phase IV (Isolation)
Support	Establish three river crossing sites (bridging if required)	Maintain three bridging sites. Maintain crossing site; facilitate mobility of UA3	Maintain three bridging sites	
Sustain	Set logistics conditions (FARP1[d])	Maintain FARP1; establish FARP2. Maintain FARP2; establish FARP3	Establish/maintain FARP3	Sustain UE_y operations in depth

[a] Reconnaissance, Surveillance, and Target Acquisition.
[b] Long-Range Reconnaissance and Surveillance.
[c] Army Tactical Missile System.
[d] Forward Area Rearm/Refuel Point.

then facilitate the passage of UA 1 and UA 2 in turn, helping to secure their river crossing operations. Subsequent to UA 1 and UA 2 securing avenues of approach through Objective Alpha, UA 3 will conduct tactical movement and passage of lines in the vicinity of Objective Delta (shown later with UA 2). UA 3 will then rapidly maneuver on Axis Six toward Objective Golf to effect the isolation of the capital. On Objective Golf, 1st and 2nd Battalions destroy enemy forces to enable the unimpeded passage of the Stryker Division to the capital. 3rd Battalion completes the isolation to facilitate a regime change. The scheme of maneuver of UA 3 is depicted in Figure B.4.

Figure B.4
UA 3 Scheme of Maneuver

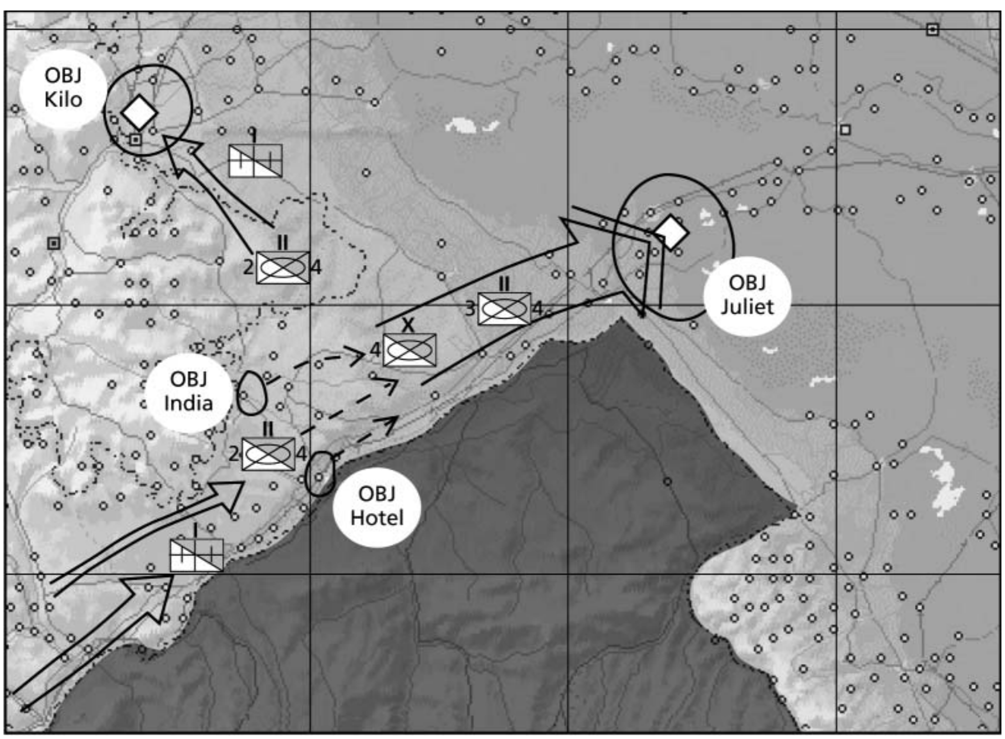


RAND *TR-302-B.4*

UA 4. UA 4 attacks in the south to secure maneuver space, reduce enemy air defense and fire support capabilities in the south, facilitate employment of joint air and facilitate the main attack in the north. Simultaneous with the initiation of UA 3's tactical movement, UA 4 initiates an air assault from Tactical Assembly Area Minor with two companies of 1st Battalion to seize Objectives Hotel and India (two airfields and surrounding areas). UA 4 then executes linkup with the ground vehicles of 1st Battalion. 3rd Battalion follows, executes a passage of lines, and attacks toward Objective Juliet to seize a major airfield and destroy enemy forces in the vicinity. 2nd Battalion executes a passage of lines and attacks north toward Objective Kilo to seize a major airfield and to destroy enemy forces. Subsequently, 1st Battalion follows and supports the attack of 3rd Battalion toward the northeast. The scheme of maneuver of UA 4 is depicted in Figure B.5.

UA 1. In the north, subsequent to UA 3 securing crossing sites, UA 1 attacks across the border to destroy enemy forces in the vicinity of Objective Alpha to facilitate the forward passage of UA 2 toward Objective Alpha and beyond to attack enemy forces in the vicinity of Objectives Charlie, Delta, and Bravo. 1st Battalion of UA 1 supports by fire from just west of Objective Alpha. 2nd Battalion is the main effort. 2nd Battalion and UA 1 Aviation Detachment attack from the northwest to destroy enemy forces on Objective Alpha, and secure Objective Alpha 1 and the northern routes to Objective Alpha. 3rd Battalion maneuvers into Objective Alpha 2 to destroy enemy forces to support the 2nd Battalion attack, to secure Alpha 2, and to block enemy forces in the vicinity of Objective Bravo to facilitate the maneuver

Figure B.5
UA 4 Scheme of Maneuver



RAND *TR-302-B.5*

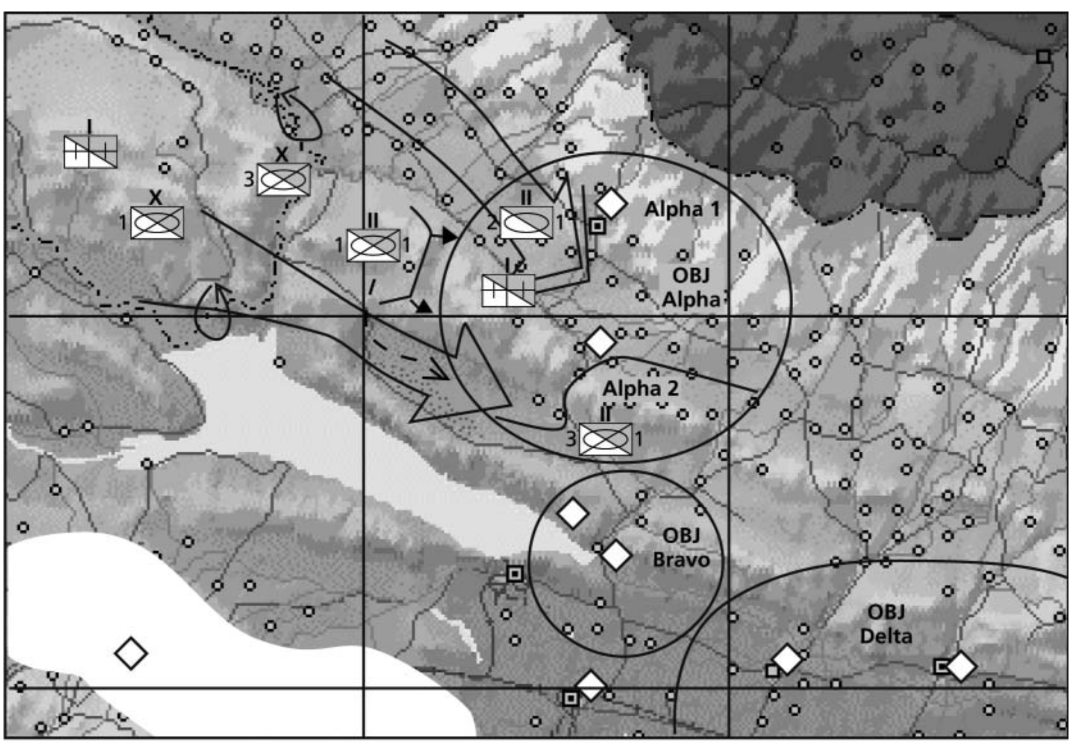
of UA 2. A sustainment and replenishment site is established in the northwestern portion of Objective Alpha to facilitate the 2nd Battalion's rapid transition to follow-on operations. UA 2 maneuvers through the northern portion of Objective Alpha, while UA 3 maneuvers through the southern portion of Objective Alpha. The scheme of maneuver of UA 1 is depicted in Figure B.6.

UA 2. UA 1 sets the conditions in Objective Alpha to facilitate UA 2's maneuver (toward Objective Alpha and beyond to attack enemy forces in the vicinity of Objectives Charlie, Delta, and Bravo, in turn). Then, the 1st and 3rd Battalions of UA 1 establish attack by fire positions north of Objective Bravo to facilitate the blocking of enemy forces that might move north from that objective area. 1st Battalion of UA 2 attacks and secures Objective Charlie, establishes support by fire positions, and supports the 2nd Battalion main attack into Objective Delta. 2nd Battalion secures Delta 1 and, turning westward as required, blocks any enemy moving from the vicinity of Objective Bravo. 3rd Battalion conducts a supporting attack, supported by the UA 2 Aviation Detachment, to secure Delta 2. UA 2 forces do not enter large towns prior to the penetration. The scheme of maneuver of UA 2 is depicted in Figure B.7.

Grid Coordinate System

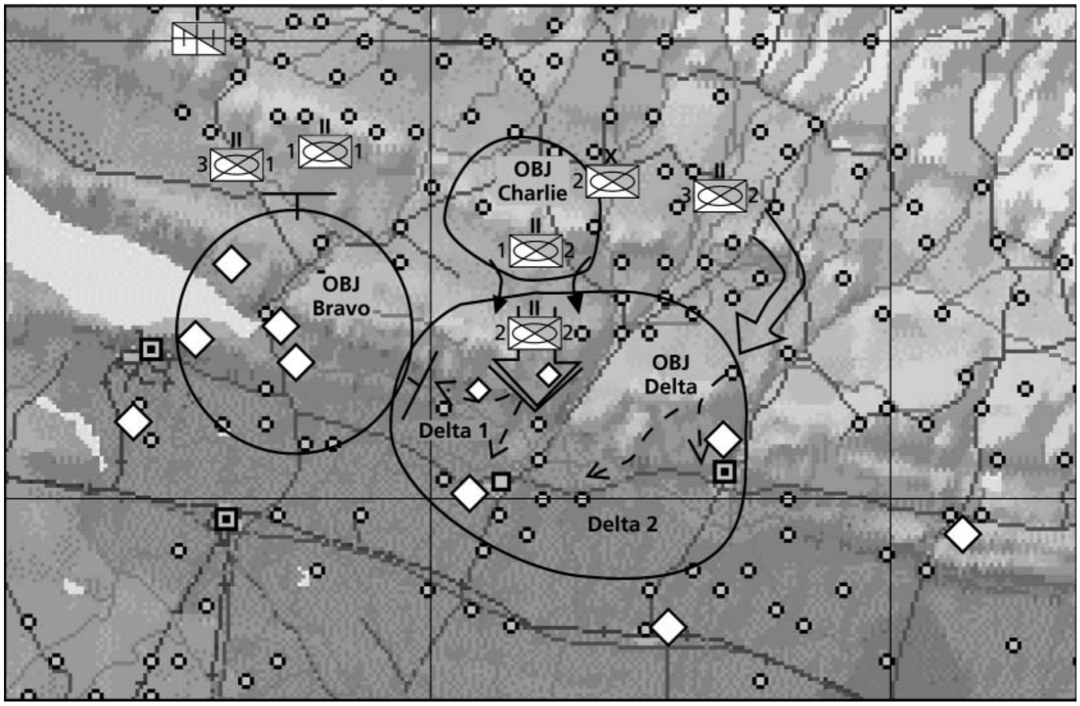
The grid coordinate system that was used in the workshop is shown Figure B.8. TRAC established a lower left corner (0,0) point of origin for the entire UE AO as shown, and translated the map sheets to a common grid.

Figure B.6
UA 1 Scheme of Maneuver



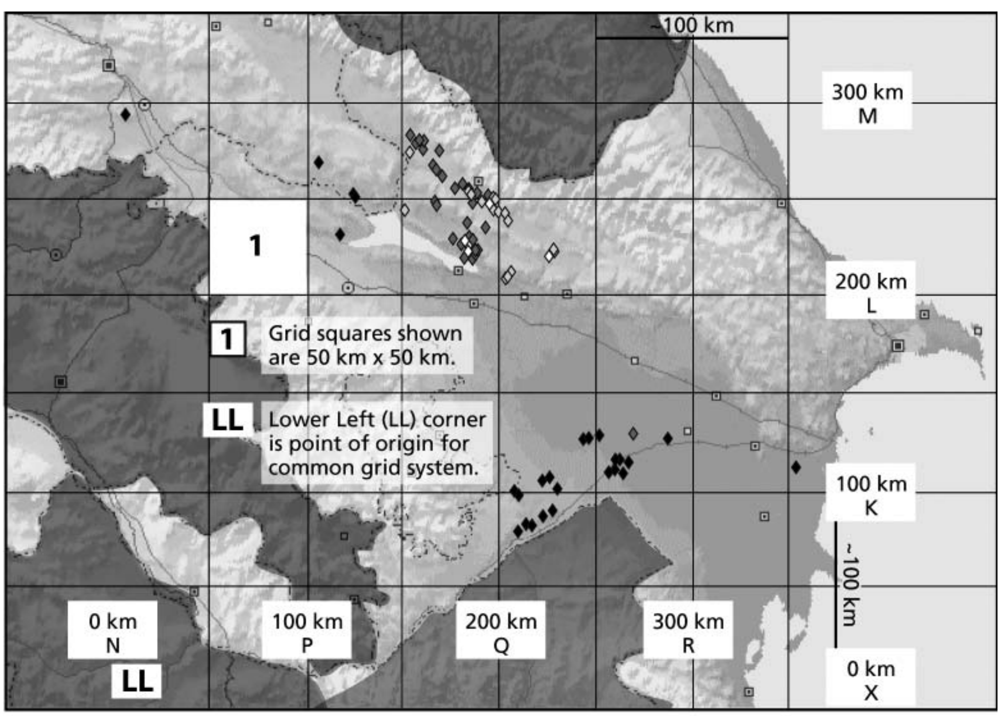
RAND *TR-302-B.6*

Figure B.7
UA 2 Scheme of Maneuver



RAND *TR-302-B.7*

Figure B.8
Grid Coordinate System



RAND *TR-302-B.8*

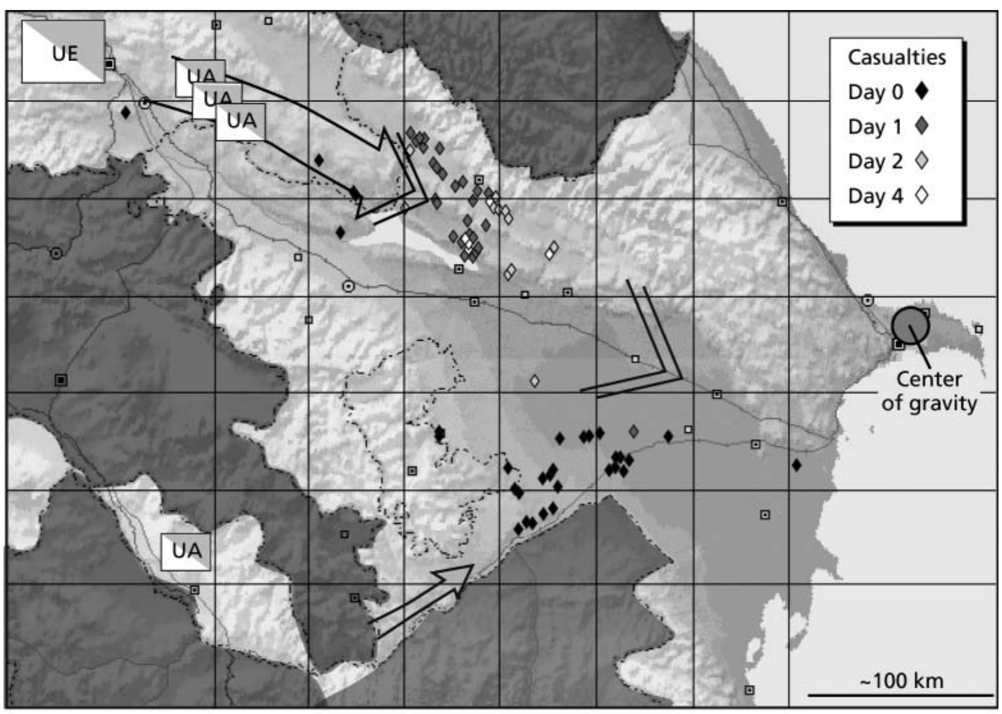
FSB Locations

The FSTs are collocated with the FSBs. In addition, a combat support hospital is established in Tactical Assembly Area Major, vicinity coordinates 002000 308000, and a CSH(–) at Tactical Assembly Area Minor, vicinity coordinates 040000 045000.

Unit of Employment Casualty Distribution

TRAC simulated the operation described above with the Vector-in-Command simulation. The Center for AMEDD Strategic Studies (CASS) derived a casualty distribution from the distribution of system losses (including dismounted soldiers) that resulted from the simulation. Simulated operations began at H + 0 and concluded just over four days later. Blue destroyed one enemy brigade in the north to open maneuver space and rapidly exploited this success with simultaneous UA-based attacks, defeating three additional enemy brigades. Blue defeated two enemy brigades in the south. Finally, Blue maneuvered a Maneuver UA to positions around the enemy capital, effectively isolating it. The distribution of UE casualties, by day of the operation, is shown in Figure B.9. Table B.2 shows the total casualty distribution and casualty surges.

Figure B.9
UE Casualties



RAND *TR-302-B.9*

Table B.2
Casualty Distribution and Casualty Surges

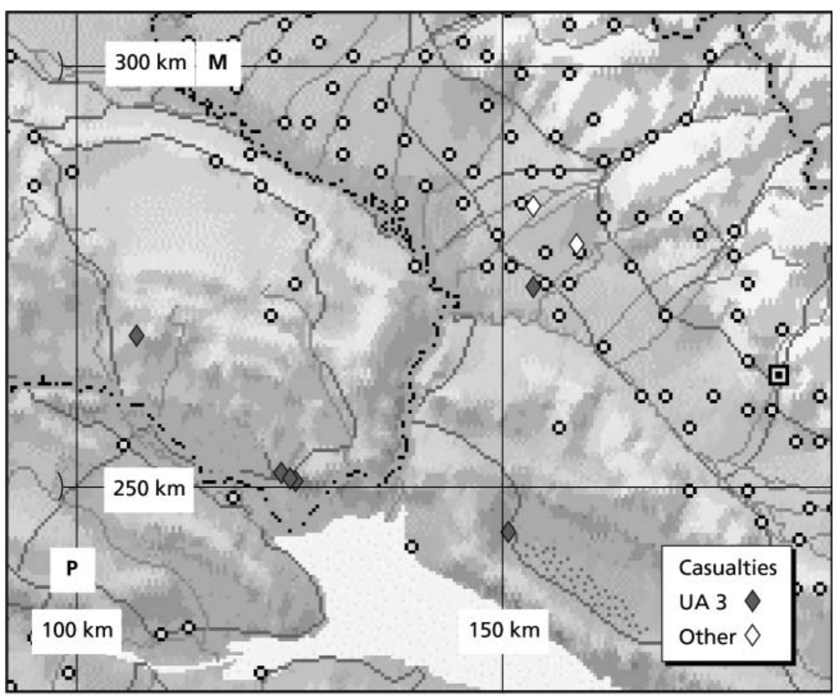
	Casualty Demand (total)	Casualty Demand (surge)	Surge Period (hours)	Rate (casualties per hour during surge)
CSOTF	6			
UE_x	7			
UA 1	217	206	23	9.0
		7	0.8	9.2
UA 2	66	63	10.9	5.8
UA 3	20	11	4.1	2.7
		9	9.9	.9
UA 4	129	127	7.3	17.5
Total	435			

NOTES: The 6 CSOTF casualties were not included in the total casualty count for ATW V. Absent these casualties, the total casualty count was 429.

UA 3 Casualties

UA 3 began taking casualties just past H+6 hours. The 20 casualties for whom UA 3 was responsible occurred during two surges. Except for three, they occurred at locations that were widely dispersed throughout the UA 3 area of responsibility. UA 3 casualties ceased prior to H+54 hours. The casualty distribution of UA 3 is shown in Figure B.10.

Figure B.10
UA 3 Casualty Distribution



RAND *TR-302-B.10*

UA 4 Casualties

UA 4 began taking casualties just past H+12 hours. The 129 casualties from UA 4 occurred during one period of approximately seven hours, across the objective area, although several clusters developed, as shown in Figure B.11. The last UA 4 casualties occurred prior to H+26 hours.

UA 1 Casualties

UA 1 began taking casualties after H+26 hours. Most of the 217 casualties from UA 1 occurred during a 23-hour surge. These occurred throughout the objective area, although they were clustered in several smaller areas, as shown in Figure B.12. After a significant break of just over 50 hours, the last UA 1 casualties occurred, prior to H+101 hours.

UA 2 Casualties

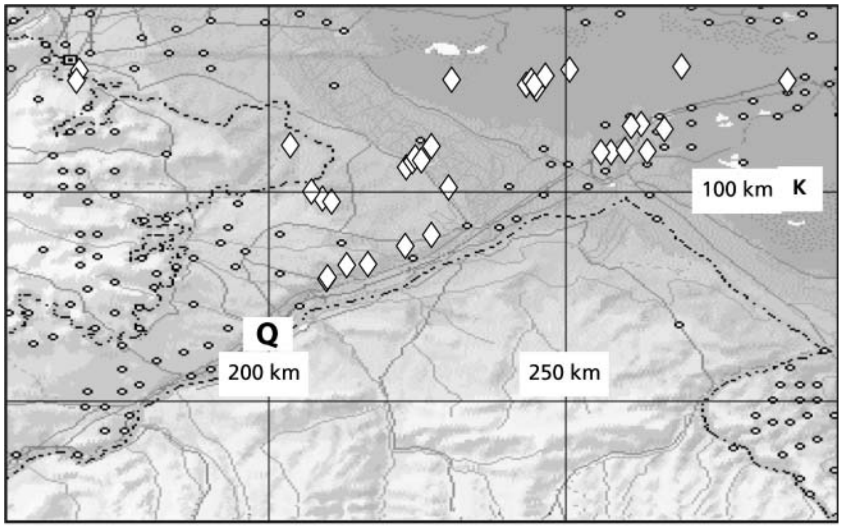
UA 2 began taking casualties after H+43 hours. Most of the 66 casualties from UA 2 occurred during a surge of almost 11 hours. These mainly clustered in several distinct areas, as shown in Figure B.13. Again, after a significant break of over 47 hours, the last UA 2 casualties occurred, just after H+101 hours.

Other Medical Support Considerations

There were a number of other medical considerations in ATW V. Figure B.14 depicts these considerations and the scheme of maneuver. These medical considerations included the following:

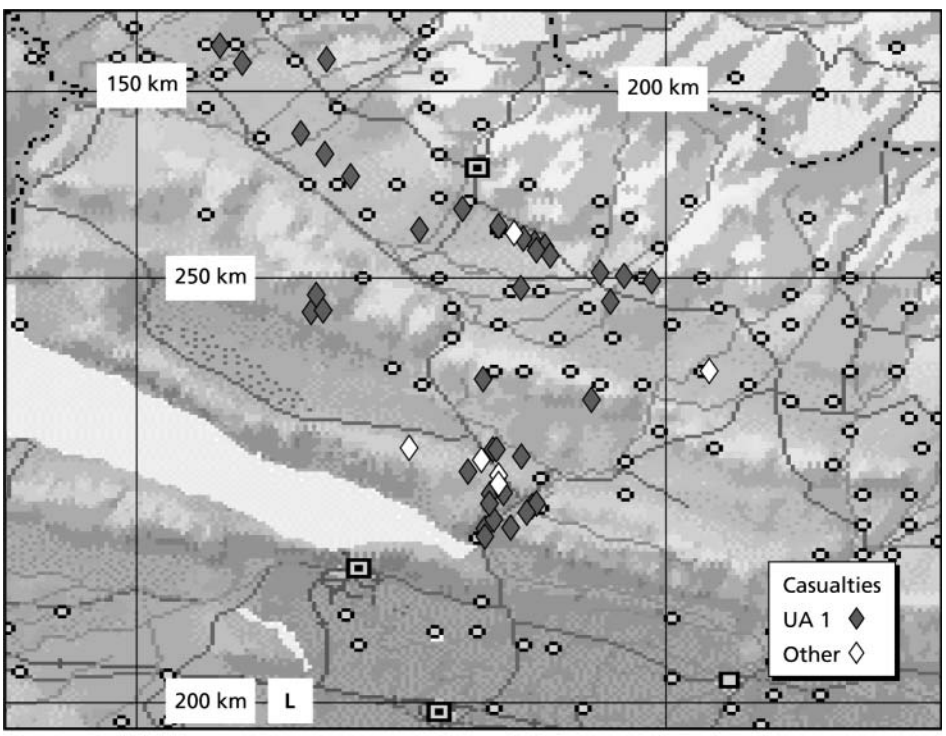
- UE_y patients at risk (PAR) were not definitively established because of a lack of development of complete Future Force structure in the scenario. It was considered to be not more than 60,000.
- Displaced person camps were present in the scenario. The scheme of maneuver avoided them.
- Enemy prisoner of war (EPW) support requirements were not definitive and were not considered in ATW V.
- Neutral forces might have added to the demand for medical support, but they were not considered in ATW V.

Figure B.11
UA 4 Casualty Distribution



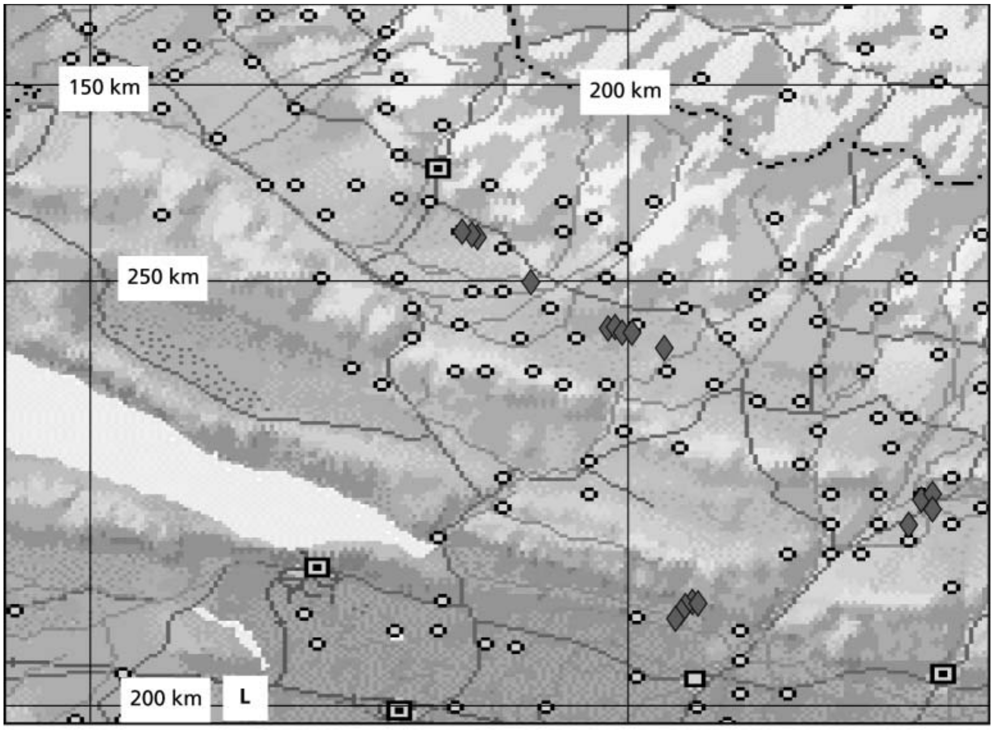
RAND *TR-302-B.11*

Figure B.12
UA 1 Casualty Distribution



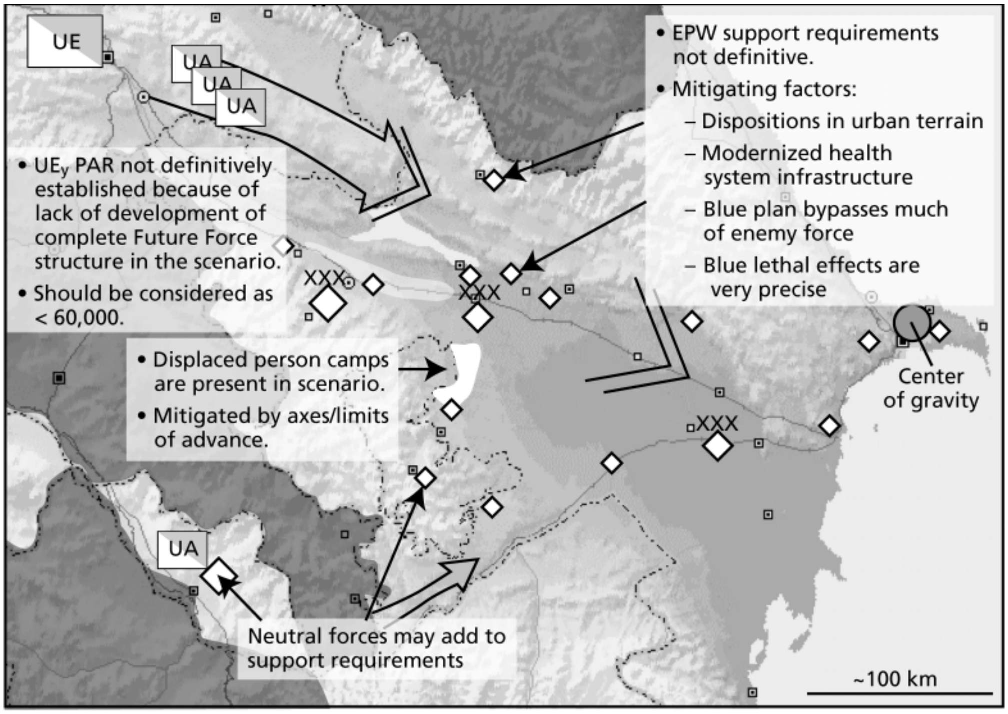
RAND *TR-302-B.12*

Figure B.13
UA 2 Casualty Distribution



RAND *TR-302-B.13*

Figure B.14
Other Medical Support Considerations



RAND *TR-302-B.14*

APPENDIX C

Medical Technologies Employed in ATW V

The following advanced medical technologies were deemed by MRMC to be feasible and due to be fielded by 2015, and they were employed by the workshop participants. These technologies, and their descriptions, were developed for use during ATWs I–IV. MRMC asked that the same technologies be used for ATW V. Their status has not been updated since ATW III. Descriptions for each of these technologies, as provided by MRMC in March 2002, follow.

1. Warfighter Physiological Status Monitor (WPSM)
2. Universal Red Blood Cells for Severe Hemorrhage
3. Universal Freeze-Dried Plasma
4. Spray-on Protective Bandage
5. Machine Language Translation
6. Liquid Tourniquet
7. Lightweight Extremity Splint
8. IV Hemostatic Drug
9. Intracavitary Hemostatic Agent
10. Enzymatic Wound Debridement
11. Battlefield Medical Information System Telemedicine
12. Advanced Resuscitation Fluid
13. Advanced Hemostatic Dressing
14. Warrior Medic (“biocorder”)
15. Hemoglobin-Based Oxygen Carrier
16. Field Therapy Utility Pack for Laser Eye Injury
17. Digital Information and Communications System
18. Transportable Automated Life Support System
19. Teleconsultation/Teledermatology
20. High-Intensity Focused Ultrasound
21. Forward-Deployable Digital Medical Treatment Facility

1. Warfighter Physiological Status Monitor

Summary: Networked array of physiological sensors embedded in the Objective Force Warrior (OFW) suit and transparent to the soldier. Data management algorithms in the soldier computer reduce near-real-time physiological data from the sensors to information useful to medics and commanders.

Capabilities and indications for use: Monitoring capability includes remote triage (determination of life signs, blood pressure, respiratory function, neurological status, ballistic wounding alert) and force health protection monitoring (thermal stress risk, hydration state, sleep status, mental alertness status, metabolic status/energy reserve, altitude adaptation, and potential exposure to toxic chemicals and materials on the battlefield).

User(s): Every soldier equipped with the OFW suit.

First fielding date: FY11.

Distribution: Monitoring capability in every OFW suit.

Training: No training required. Complex physiological data will be reduced to easy-to-understand information for medics and commanders about the physiological status of individual soldiers and units.

Cube and weight: Sensors will add about a pound to the OFW suit.

Cost: MRMC medical research will provide the sensor specifications and data management algorithms. The OFW suit developer will develop or purchase the sensors and include the data management algorithms in the soldier computer.

2. Universal Red Blood Cells for Severe Hemorrhage

Summary: The product is non-type-specific red blood cells for battlefield blood replacement.

Capabilities and indications for use: The successful product will eliminate the need for blood typing, reduce the logistics footprint, and can be used in a far-forward environment to improve organ oxygenation in severe hemorrhage and to stabilize combat casualties in scenarios of delayed evacuation.

User(s): Physician assistant, surgeon.

First fielding date: 2015.

Distribution: 10 units at battalion aid station PA. 50 per FST.

Training: Training in proper indications for use and in intravenous access and administration.

Cube and weight: 0.75 pound per 250 ml unit with administration set and packaging.

Cost: $150 per unit.

3. Universal Freeze-Dried Plasma

Summary: The product is freeze-dried plasma that is not type-specific and is packaged for rapid reconstitution and administration on the battlefield by the combat medic or the physician assistant.

Capabilities and indications for use: The product is freeze-dried (lyophilized) plasma that is not type-specific and is packaged for rapid reconstitution and administration on the battlefield for control of hemorrhage. The product can be carried without significantly adding to the medic's battlefield load and when reconstituted and administered will provide functional activity similar to native plasma. The product will eliminate the need for blood typing, will reduce the logistical footprint, and can be used in a far-forward environment for casualty resuscitation.

User(s): Combat medic, physician assistant, surgeon.

First fielding date: 2012.

Distribution: 4 units per combat medic and PA, 50 units per FST.

Training: Training in indications for use; training in intravenous access and administration.

Cube and weight: Each unit will come as prepackaged intravenous bag (with IV setup) with 2 compartments, one containing freeze-dried plasma, the other sterile water for injection. The two compartments must be joined and mixed for use. Each package will be 250 ml and weigh 0.75 pound. No maintenance is required.

Cost: $50/unit.

4. Spray-on Protective Bandage

Summary: A spray-on, self-sanitizing, flexible bandage that will reduce or eliminate blood and fluid loss; will reduce or eliminate pain associated with motion; and will protect wounds from environmental contamination.

Capabilities and indications for use: The spray-on bandage may be self- or buddy-applied and will enhance wound stabilization for 2 or more days after injury. The bandage will be applicable to large and small wounds and will be self-sanitizing (antimicrobial) and capable of reducing or stopping blood and fluid losses (including compressible hemorrhage and amputation stumps after minimal tourniquet control); reducing or eliminating pain during motion; and protecting wounds from environmental contamination. May be used in conjunction with enzymatic/chemical debridement.

User(s): Combat lifesaver, combat medic; PA; surgeon.

First fielding date: 2010.

Distribution: One tube per soldier. One tube covers wounds up to 50 percent of total body surface.

Training: Minimal training required; will be applied directly to wound surface.

Cube and weight: Final form not established. Attempts are being made to deliver dressing as a powder that will use wound liquid (blood, serum) to polymerize on wound surface.

Cost: $50 per unit.

5. Machine Language Translation

Summary: The goal of the machine language translation project is to build and deliver a 2-way machine voice translation system on a small, rugged, handheld computer/Personal Digital Assistant.

Capabilities and indications for use: Machine language translation uses computers to translate free speech from one language into another: for example Spanish into Ukrainian. A handheld computer with this technology will enable deployed medical personnel to communicate/interact with and provide immediate care to non-English-speaking patients (e.g., during humanitarian assistance operations, unconventional operations, etc.). This device will also enhance the situational awareness of military personnel, and improve the speed and precision in coalition/ally collaboration (and decisionmaking) via automated translingual access to Command, Control, Communications, Computers, and Intelligence (C4I).

User(s): Combat warfighter, medical personnel (medics, physician's assistant, and physicians) and other military personnel that may interact with an indigenous population (e.g., chaplains, military police, civil affairs).

First fielding date: July 2003.

Distribution: The device has been tested in Operation Enduring Freedom and Operation Iraqi Freedom with the civil affairs units, medical personnel, etc.

Training: The military personnel need to be trained on the system and the system needs to be trained to their voice.

Cube and weight: Height: 5.3 in; width: 3.3 in; depth: 0.62 in; weight: 6.7 oz, recognizer board: 9 oz.

Cost: $1,800 for each unit; the cost includes the cost of the rugged PDA and also the rugged recognizer speech board.

6. Liquid Tourniquet

Summary: A lightweight polymerizing gel that will be used for compressible hemorrhage or amputation. If a tourniquet is required to stop extremity bleeding, it will only be applied for the time necessary for placement of gel into/onto the wound surface and gel polymerization (less than 15 minutes). Expected to result in much greater survival and function of muscle and tissue currently lost by long-term placement (greater than 2 hours) of current tourniquet system. Will allow stabilization of wounds for several days under battle conditions.

Capabilities and indications for use: Will allow compressible hemorrhage to be buddy- or self-treated. Gel will be applied directly to wound and compressed by field dressing or by temporary use of standard one-handed tourniquet with placement of gel on stump and removal of tourniquet. Material will provide several days of wound stabilization and protection from environmental contamination.

User(s): Soldier, combat medic, PA, FST. Will be packaged as component of and distributed with field dressing and one-handed tourniquet.

First fielding date: 2010.

Distribution: One per current field dressing and tourniquet.

Training: Hands-on training will be required.

Cube and weight: Device will be less than 0.25 pound; one use disposable.

Cost: $10 for field dressing and $50 for tourniquet per use.

7. Lightweight Extremity Splint

Summary: The lightweight extremity splint will allow soldiers with immobilized and nondisplaced fractures to continue their mission and soldiers with serious open fractures to be stabilized and unit transportable for several days under battle conditions.

Capabilities and indications for use: The splint will be fabricated from new, lightweight material(s) and will be deployable far forward in the battle area. The field medic or "buddies" on the battlefield or medical officers at the forward surgical team, or equivalent, will use it for open fractures and external fixation splints. The lightweight extremity splint will enable the soldier with a single upper extremity fracture to remain functional, perhaps even operating an individual weapon until evacuation. A war fighter with a lower extremity fracture will be able to ambulate with crutches and perhaps one other person instead of requiring a stretcher and 2 or more stretcher bearers. In both cases, the functional capabilities of a team with an extremity fracture will be improved.

User(s): Buddy care, combat lifesaver, combat medic, PA, surgeon.

First fielding date: 2010.

Distribution: One arm and one leg splint per 10 soldiers.

Training: Hands-on training will be required. Device will be a balloon sleeve with a pressure limiting valve and self-contained flexible air pump.

Cube and weight: Device will be less than 0.25 pound; one use disposable.

Cost: $100/set (one leg/one arm).

8. IV Hemostatic Drug

Summary: An IV agent that will safely enhance the ability of the combat casualty with hemorrhage to form natural clots and stop hemorrhage on the battlefield.

Capabilities and indications for use: The hemostatic drug is an IV agent that will safely enhance the ability of the combat casualty to form natural clots and stop hemorrhage on the battlefield. The agent will effectively treat casualties who have experienced serious hemorrhage.

User(s): Combat medic, physician assistant, surgeon.

First fielding date: 2010.

Distribution: 2 doses per medic and PA, 20 per FST.

Training: Users must be trained in proper indications for use, i.e., uncontrolled, especially, noncompressible hemorrhage.

Cube and weight: 20 ml syringe per dose.

Cost: $500 per dose.

9. Intracavitary Hemostatic Agent

Summary: The intracavitary hemostatic agent will be provided in foam, gel, or liquid form that can be introduced into a body cavity via a large-bore needle (without surgery) to slow or stop internal hemorrhage.

Capabilities and indications for use: In the far-forward environment, the intracavitary hemostatic agent will be especially useful to stop internal bleeding.

User(s): Combat medic, PA, surgeon.

First fielding date: 2015.

Distribution: 2 doses per combat medic, 5 per PA, 20 per FST.

Training: Training in proper indications and techniques for use.

Cube and weight: 50 ml per dose, preloaded syringe; 4 oz per dose including packaging.

Cost: $400/dose.

10. Enzymatic Wound Debridement

Summary: A spray-on, self-limited enzymatic/chemical and analgesic debridement system for chemical and burn injuries prior to covering with a spray-on bandage.

Capabilities and indications for use: The spray-on enzymatic/chemical debridement system may be self- or buddy-applied and will enhance wound cleaning and stabilization for 2 or more days after injury. Debridement will be applicable to large and small wounds and may be used before application of or, perhaps, integrated with the spray-on bandage.

User(s): Soldier, combat lifesaver, combat medic, physician assistant, surgeon.

First fielding date: 2010.

Distribution: 50 ml tube per soldier and stored at first PA level.

Training: Minimal training requirement. Debridement will be self-limiting.

Cube and weight: 50 ml; flexible tube; less than 0.1 pound.

Cost: $10 per tube.

11. Battlefield Medical Information System Telemedicine (BMIST)

Summary: BMIST is a wireless hand-held assistant designed to record the essential elements of a medical history and physical examination and then provide the medical analysis and decision support for first responders. It uses a wireless, flexible, and scalable personal data assistant that can be used by military health care providers at all levels of care from the foxhole to the medical center. It is the ideal tool to meet the military objective of providing useful medical informatics and telemedicine support for first responders across the spectrum of military health care operations and continuum of support levels of care.

Capabilities and indications for use: BMIST enables first responders (and other health care staff) to quickly and accurately capture, integrate, transmit, and display data from medical histories/physical examinations, medical reference libraries, diagnostic and treatment decision aids, medical sustainment training, and medical mission planning using a wireless, hand-held assistant. To meet the needs of first responders with varying levels of expertise and experience, BMIST will support a user interface that includes help windows and decision rationale. BMIST will also provide the flexibility to adapt to evolving medical procedures and protocols, as well as to accommodate additional or new medical databases and mission requirements. When adequate communications are available, BMIST will support real-time "teleconsultation" between the first responder and expert medical staff (e.g., physician) residing in different locations.

User(s): Combat lifesaver, combat medic, PA, battalion/brigade surgeon.

First fielding date: Summer 2002 (initial prototype field tests).

Distribution: One per combat infantry medic.

Training: Minimal (estimated under 1 hour for untrained users, the interface is user friendly and is an intuitive part of their business process).

Cube and weight: The Pocket PC Platform is 5.3 in by 3.3 in by 6.2 in, 6.7 oz; BMIST is software.

Cost: Hand-held commercial $500 per unit, software undetermined (estimate under $100 per license if commercialized).

12. Advanced Resuscitation Fluid

Summary: A resuscitation fluid that sustains wounded soldiers and preserves organ integrity and function even in the face of small-volume fluid resuscitation and hypotension.

Capabilities and indications for use: The advanced resuscitation fluid will require less fluid to maintain critical levels of blood pressure and tissue perfusion. It will reduce the mortality and late morbidity associated with trauma and serious blood loss by reducing vascular injury and immune system activation caused by decreased blood perfusion and oxygen radical generation during tissue reoxygenation. The fluid will be well suited for small-volume resuscitation for trauma and blood loss with delayed evacuation for up to 72 hours.

User(s): Combat medic, PA, and surgeon.

First fielding date: 2015.

Distribution: 6 units of this resuscitation fluid will be distributed to each medic in the Future Force for far-forward resuscitation, 10 units to each battalion aid station, and 20 units to each FST.

Training: The advanced resuscitation fluid will be used as current resuscitation fluids so no additional training will be required.

Cube and weight: 500 cc bags weighing 0.5 kg, including packaging and administration set.

Cost: $50/500 ml unit.

13. Advanced Hemostatic Dressing

Summary: The advanced hemostatic dressing will stop lethal severe arterial or large venous hemorrhage within 2 minutes. In the far-forward environment, this will be most useful for compressible hemorrhage.

Capabilities and indications for use: The advanced hemostatic dressing will stop lethal severe arterial or large venous hemorrhage within 2 minutes. It may be applied externally or internally. It will be used in the far-forward environment, especially for compressible (external) hemorrhage, and in the FST.

User(s): Soldier, buddy aid, combat lifesaver, combat medic, PA, surgeon.

First fielding date: 2007.

Distribution: One per soldier, 5 per combat medic and PA, 20 per FST.

Training: Hands-on training for all users.

Cube and weight: 0.25 pound per dressing, size of current bandage. No maintenance requirement.

Cost: $100 per dressing.

14. Warrior Medic ("Biocorder")

Summary: A hand-held device used by combat medics to detect or collect and analyze physiological and metabolic information in combat casualties. The sensors and other capabilities of the Biocorder will interface with physiologic sensors that are part of the WPSM and will provide supplementary physiological data for use by the combat medic for casualty management. Results of analysis are displayed as well as the recommended actions to be taken by the medic.

Capabilities and indications for use: The Biocorder provides the combat medic with the capability to collect casualty data and provides assistance and guidance to the medic for best casualty management. The Biocorder will enhance casualty management far forward on the battlefield by providing real-time physiological and vital signs information to the medic. Return to duty of minor casualties will be accelerated. Evacuation demand will be reduced and/or more accurately targeted to appropriate casualties. The Biocorder will be capable of communicating with the physiological sensors in the WPSM. The Biocorder will monitor and log ECG, cardiac output, blood pressure, peripheral resistance, heart rate, respiratory rate, oxygen saturation, body temperature, acoustic heart and lung sounds and blood chemistries. The Biocorder will be equipped to drive miniature IV infusion pumps based on blood pressure for both resuscitation and drug infusion.

User(s): Combat medic, PA, surgeon, nurses.

First fielding date: 2015.

Distribution: One per combat medic, 3 per FST, 10 per holding company, 1 per ambulance, 50 per CSH.

Training: Physicians and nurses, combat medic (2 hrs), unit-level maintenance (2 hrs), depot-level maintenance (5 hrs).

Cube and weight: Hand held 6 in by 6 in by 2 in (.04 cu. ft) weighing < 1 pound.

Cost: 5,000 units * $2,000/unit = $10M.

15. Hemoglobin-Based Oxygen Carrier

Summary: The hemoglobin-based oxygen carrier will provide a temperature-stable alternative to red blood cells.

Capabilities and indications for use: The hemoglobin-based oxygen carrier will provide an alternative to red blood cells that can be deployed far forward. The product will remain stable and functional in a wide range of ambient temperature conditions and can be rapidly administered to provide replacement of oxygen-carrying capacity in casualties who have experienced significant blood loss on the battlefield. The product will effectively stabilize patients with severe blood loss during extended evacuation delay.

User(s): Combat medic, PA, surgeon.

First fielding date: 2007.

Distribution: 4 units per combat medic and PA, 50 per FST.

Training: Training in indications for use and in intravenous access and administration.

Cube and weight: Each unit with administration set is 0.75 pound with packaging.

Cost: $400/unit.

16. Field Therapy Utility Pack for Laser Eye Injury

Summary: Field therapy utility pack containing a diagnostic card and therapeutics that can be easily administered by a combat medic immediately after injury to prevent secondary retinal degeneration and vision loss.

Capabilities and indications for use: Provides diagnostic tools for rapidly assessing injury severity, retinal location, and presence of hemorrhage. Provides treatments that can curtail degenerative processes and conserve vision.

User(s): Combat medic.

First fielding date: 2009.

Distribution: One kit per combat medic.

Training: Combat medic requires training to use diagnostic tools and administer therapeutic agents.

Cube and weight: About 1 pound.

Cost: Unknown.

17. Digital Information and Communications System

Summary: The goal of the digital information and communications system is to create and support a medical global information grid that will extend far forward into a combat zone.

Capabilities and indications for use: The digital information and communications system consists of two major components: the Special Medical Augmentation Response Team for Medical Command, Control, Communications and Telemedicine (SMART MC3T) package and Warfighter Information Network—Proof of Concept (WIN-POC). The SMART MC3T package will enable soldiers to establish medical communications (e.g., self-sufficient Internet and telephony coverage) capability in remote areas where communication infrastructure is unavailable or not functional. This capability will enable support to deployed specialty teams (e.g., trauma/critical care, stress management) and provide on-scene commanders with a real-time "reach-back" capability to medical specialists and/or commanders. This global information grid will be extended by WIN-POC, which is a mobile, powerful communications node mounted on a field vehicle. WIN-POC will provide seamless, broadband communications from forward-deployed areas to Theater and National Military Command Headquarters and Military Health System Medical Centers worldwide. It will function as a platform for multiuser broadband medical command-and-control communications and telemedicine connectivity. The entire system provides a seamless, modular, expandable, and secure manner in which to rapidly acquire, transfer, and display critical medical and logistical information in a battlefield (or other operational) environment.

User(s): Combat medic, nurse, PA, battalion/brigade surgeon, medical support personnel, and other medical commanders.

First fielding date: November 1999–October 2000, initial acquisition and integration of digital communication systems; October 2000–November 2001, Technology Integration testing and evaluation at AMEDD Exercise 2000, TX and Joint Readiness Training Center Advanced Warfighter Experiment, Fort Polk, LA; November 2001–October 2008, identify, acquire, and integrate wireless technologies to facilitate improvement of the quality of care provided by AMEDD deployable organizations to forward-deployed military personnel.

Distribution: Forward-deployed medical units for the SMART MC3T; and brigade support areas for the WIN-POC.

Training: 5 days training for the SMART MC3T; 2 weeks to 30 days for the BRSS; 3 months to 1 year for the WIN-POC.

Cube and weight: 76 pounds, 6 cubes for the complete set (for SMART MC3T).

Cost: SMART MC3T: $385K FY02, $269K FY03–06; WIN-POC: $300K FY02, $350K FY03–06; BRSS: $150K per unit; WIN-POC: approximately $1.1M each vehicle.

18. Transportable Automated Life Support System (TALSS)

Summary: A portable, self-contained, lightweight (<40 pounds), protected environment for one casualty, capable of providing sustained monitoring and automated life support for combat casualties for up to 72 hours on the battlefield.

Capabilities and indications for use: The TALSS provides automation of life support functions, providing computer-driven closed-loop control of ventilation, fluid, drug, and oxygen administration. The system optimizes the patient's treatment, while minimizing resource utilization. The automated capability of the TALSS is a force multiplier for the small FST staff and for the 91W staffing the ambulance by freeing them to care for other casualties once they have stabilized a seriously injured casualty. The system will also provide data-logging and telecommunication capability to facilitate record keeping and to enable real-time communication of patient data to the receiving hospital for assistance with monitoring and decisionmaking from a remote location. The TALSS will provide increased and improved holding capability at the FST as well as extended critical-care capability within the ground ambulance platform by providing automated life support for the critically injured awaiting and during evacuation.

User(s): PA, surgeon, medics (91W), nurses (91C).

First fielding date: 2015.

Distribution: 4 per FST, 10 per holding company, 10 per ambulance company, 30 per CSH.

Training: Medical personnel (1 hr), unit-level maintenance personnel (2 hrs), depot-level maintenance (24 hrs).

Cube and weight: 40 pounds, 5 cu ft., 4 cu ft. resupply bag.

Cost: 500 units * $100K each = $50M.

19. Teleconsultation/Teledermatology

Summary: Teleconsultation is the application of information and telecommunications technologies to facilitate delivery of medical treatment across all barriers. Teledermatology is a proven, clinically focused teleconsultation system designed to enable dermatology interactions between various parties located anywhere in the world.

Capabilities and indications for use: Dermatology is one of the most frequently performed telemedicine consultations within (and outside of) the Army. Currently, initial teledermatology prototypes have been deployed at 4 Army medical centers and over 60 Defense Department clinics worldwide. An advanced or "next generation" system will facilitate secure, more efficient, real-time and/or store and forward distance consultation and treatment. A more portable teledermatology system will better serve highly mobile, dispersed forces engaged in a variety of operations (e.g., humanitarian assistance, unconventional warfare), thereby facilitating force readiness and effectiveness, and in general, promote (force) health protection.

User(s): Combat medic, nurse, PA, battalion/brigade surgeon, dermatologist (specialty).

First fielding date: April 1999.

Distribution: 4 Army medical centers and over 60 Defense Department clinics worldwide.

Training: User training on software application and digital camera photography is provided onsite by a local trainer.

Cube and weight: Commercial-off-the-shelf/government-off-the-shelf software installed on COTS central processing unit with current browser capability and digital camera.

Cost: Workstation: ~$4,000 (includes one workstation, one digital camera, and software). Server: ~$12,000 (includes one server and software).

20. High-Intensity Focused Ultrasound

Summary: The high-intensity focused ultrasound device will provide cauterization of both internal and external bleeding structures without damaging overlying tissues. The device will feature a computerized Doppler guidance system designed to locate and focus on hemorrhaging structures.

Capabilities and indications for use: The high-intensity focused ultrasound device functions by focusing ultrasonic waves to cause cauterization of bleeding structures without damaging overlying or surrounding tissues. The hand-held device features a computerized Doppler guidance system designed to locate and focus on hemorrhaging structures. In the far-forward environment, the device will have the capability to successfully manage both external and internal bleeding.

User(s): PA, surgeon.

First fielding date: 2012.

Distribution: One per battalion aid station, 2 per FST.

Training: Proper indications and techniques for use.

Cube and weight: 1 cubic foot per unit, 15 pounds per unit.

Cost: $50,000 per unit.

21. Forward-Deployable Digital Medical Treatment Facility (FDDMTF)

Summary: The FDDMTF will provide a lightweight, wireless, digitized forward surgical capability that can be deployed across a range of military operations.

Capabilities and indications for use: The FDDMTF supports Army Transformation by reducing weight and cube, airframe requirements, providing essential care in theater, and reach-back capabilities. Utilizing a 10–25 bed Air Force Expeditionary Medical Support Unit with digitized enhancements as the prototype "core," the FDDMTF provides a lightweight, wireless, digitized forward surgical capability that can be rapidly deployed to (medically) support a range of military operations. The FDDMTF provides 24-hour sick call and emergency medical care plus the following capabilities: medical command and control, preventive medicine, trauma resuscitation and stabilization, limited general and orthopedic surgery, critical care, primary care, and limited ancillary care to a population at risk of 2,000 to 3,000.

User(s): Combat medic, nurse, PA, battalion/brigade surgeon, and various medical support personnel.

First fielding date: 2004.

Distribution: One per Stryker Brigade Combat Team.

Training: Training required for shelter establishment, operation of the communications enhancements, and the use of wireless, digitized medical equipment. The 91W program coupled with upgrades in the biomedical maintenance course would provide the soldiers with the necessary clinical background to function effectively in the facility.

Cube and weight: 50,000 square feet, on 26–30 463L pallets (13K forklift). Figures based on equipment minus transportation assets.

Cost: $1.9M.

APPENDIX D

Casualty Tracking Worksheet Excerpt

Workshop teams were given casualty-tracking worksheets with the location and time of wounding, Patient Condition Codes, and associated Treatment Briefs (see, e.g., Table D.1) to assist them in patient regulation and treatment.[1]

---

[1] Deployable Medical System (DEPMEDS) Patient Condition Codes describe a disease or injury. Treatment briefs provide an overview of the required medical treatment for each specific case.

Table D.1
Casualty Tracking Worksheet Excerpt

Time of Wounding min	Cause of Wound	Casualty Number	Casualty's Unit	Location: Casualty Battalion Med Co/FST	Patient Condition + Treatment Brief #	Severity	Triage Category	Time Start Treatment by Medic/CLS (specify)	Time End Treatment by Medic	Outcome: *if KIA, specify if due to unavailable care or evac*	Evac Cate-gory	Evac Asset	Time Start Evac	Time End Evac	Triage Category at BAS
1601	FRAG	156	C Co (IN), 2nd CA BN, UA 1, UEx	167998 275548 163070 273898 115359 273107	48 - WOUND UPPER ARM OPEN WITH FRACTURES AND NERVE INJURY NO VASCULAR INJURY ARM SALVAGEABLE	Low Medium High	Immediate Delayed Minimal Expectant			RTD KIA care evac	Urgent, Priority, Routine				Immediate Delayed Minimal Expectant
1601	FRAG	157	C Co (IN), 2nd CA BN, UA 1, UE_x	167998 275548 163070 273898 115359 273107	122 - WOUND THIGH OPEN WITHOUT FRACTURE NERVE OR VASCULAR INJURY NOT REQUIRING MAJOR DEBRIDEMENT	L M H	I D M E			RTD KIA care evac	U P R				I D M E
1601	FRAG	158	C Co (IN), 2nd CA BN, UA 1, UE_x	167998 275548 163070 273898 115359 273107	311 - EYE WOUND LACERATED PENETRATED WITH RETINAL INJURY EYE SALVAGEABLE	L M H	I D M E			RTD KIA care evac	U P R				I D M E
1601	FRAG	159	C Co (IN), 2nd CA BN, UA 1, UE_x	167998 275548 163070 273898 115359 273107	18 - WOUND FACE JAWS AND NECK OPEN LACERATED WITH ASSOCIATED FRACTURES EXCLUDING SPINAL FRACTURES MODERATE - WITHOUT AIRWAY OBSTRUCTION; EYELID AND EYEBALL LACERATION WITH RETAINED INTRAOCULAR FOREIGN BODY	L M H	I D M E			RTD KIA care evac	U P R				I D M E
1601	FRAG	160	C Co (IN), 2nd CA BN, UA 1, UE_x	167998 275548 163070 273898 115359 273107	135 - WOUND ANKLE FOOT TOES OPEN LACERATED CONTUSED WITHOUT FRACTURES NOT REQUIRING MAJOR DEBRIDEMENT	L M H	I D M E			RTD KIA care evac	U P R				I D M E
1601	FRAG	161	C Co (IN), 2nd CA BN, UA 1, UE_x	167998 275548 163070 273898 115359 273107	52 - WOUND FOREARM OPEN LACERATED PENETRATING WITHOUT BONE NERVE OR VASCULAR INJURY MODERATE - NOT REQUIRING MAJOR DEBRIDEMENT	L M H	I D M E			RTD KIA care evac	U P R				I D M E

Table D.1—continued horizontally from previous page

Time Start Treatment at BAS	Time End Treatment at BAS	Outcome *if DOW specify if due to unavailable care or evac*	Evac Category	Evac Asset	Time Start Evac	Time End Evac	Triage Category at Med Co	Time Start Treatment at Medical Co/FST	Surgery Required at FST? *If yes, indicate start/end times*	Outcome: *if DOW, specify if due to unavailable care or evac*	Evac Cate-gory	Surgery or ICU Required at UE?	Post-Op Time Start/End	Time Ready for Evac to UE	Prognosis and Comments
		RTD KIA care evac	Urgent Priority Routine				Immediate Delayed Minimal Expectant		N Y time start: end:	RTD DOW care evac	Urgent Priority Routine	S ICU	start: end:		
		RTD KIA care evac	U P R				I D M E		N Y time start: end:	RTD DOW care evac	U P R	S ICU	start: end:		
		RTD KIA care evac	U P R				I D M E		N Y time start: end:	RTD DOW care evac	U P R	S ICU	start: end:		
		RTD KIA care evac	U P R				I D M E		N Y time start: end:	RTD DOW care evac	U P R	S ICU	start: end:		
		RTD KIA care evac	U P R				I D M E		N Y time start: end:	RTD DOW care evac	U P R	S ICU	start: end:		

Bibliography

Anderson, Robert H., and Anthony C. Hearn, *An Exploration of Cyberspace Security R&D Investment Strategies for DARPA: "The Day After—in Cyberspace II,"* Santa Monica, Calif.: RAND Corporation, MR-797-DARPA, 1996.

Bellamy, Ronald F., "Anesthesia and Perioperative Care of the Combat Casualty (Part IV: Surgical Combat Casualty Care)," in Russ Zajtchuk and Christopher M. Grande, eds., *Textbook of Military Medicine,* Washington, D.C.: Office of the Surgeon General, 1995.

Johnson, David E., and Gary Cecchine, *Conserving the Future Force Fighting Strength: Findings from the Army Medical Department Transformation Workshops,* 2002, Santa Monica, Calif.: RAND Corporation, MG-103-A, 2004.

———, *Medical Risk in the Future Force Unit of Action: Results of the Army Medical Department Transformation Workshop IV,* Santa Monica, Calif.: RAND Corporation, TR-253-A, 2005.

Johnson, David E., Gary Cecchine, and Jerry Sollinger, *Army Medical Department Transformation: Executive Summary of Five Workshops,* Santa Monica, Calif.: RAND Corporation, MG-416-A, 2006.

Joint Doctrine Division, J-7, Joint Staff, *DOD Dictionary of Military and Associated Terms,* Joint Publication 1-02. As amended through 31 August 2005, online at http://www.dtic.mil/doctrine/jel/doddict/.

U.S. Department of the Army, *FM 8-10-25: Employment of Forward Surgical Teams: Tactics, Techniques and Procedures,* Washington, D.C.: Headquarters, Department of the Army, 1997.

———, *FM 8-10-6: Medical Evacuation in a Theater of Operations: Tactics, Techniques and Procedures,* Washington, D.C.: Headquarters, Department of the Army, 2000.

———, *UA Organization and Operations Plan,* July 22, 2002.

U.S. Department of the Army, Armor Center, "The United States Army Objective Force Operational and Organization Plan, Unit of Action, Change 1 to TRADOC Pamphlet 525-3-90 O&O," Washington, D.C.: Headquarters, Department of the Army, 25 November 2002.